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COMMONWEALTH INSTITUTE OF ENTOMOLOGY.

REVIEW

OF

APPLIED ENTOMOLOGY.

SERIES A.

Vol. 40. 1952.

HEWLETT (P. S.). **Piperonyl Butoxide as a Constituent of heavy-oil Sprays for the Control of Stored Product Insects. I. Piperonyl Butoxide as a Synergist for Pyrethrum and its Effect on the Persistence of Pyrethrum Films.**—*Bull. ent. Res.* **42** pt. 2 pp. 293–310, 5 graphs, 21 refs. London, 1951.

Laboratory experiments in which adults of *Tribolium castaneum* (Hbst.) were exposed to direct sprays of Shell oil P31 containing 1·6 per cent. pyrethrins, 5 per cent. technical piperonyl butoxide (PB) or both, or confined on films deposited by these sprays, showed that PB is a powerful synergist for pyrethrins, the mixture giving considerably higher mortalities than the pyrethrins alone when the same amounts of total insecticide were applied. PB alone was virtually non-toxic as a spray, and as a film when the beetles were confined on it for six days, but produced appreciable mortality in films with longer exposure (nine days). In further tests, adults of *Calandra granaria* (L.) and *Ptinus tectus* Boield. were resistant to PB in films, but those of *C. oryzae* (L.) were somewhat susceptible.

Films of 0·4 per cent. pyrethrins with 2·5 per cent. PB and 1·3 per cent. pyrethrins alone were about equally toxic to *Tribolium*. The two films lost toxicity at about the same rate up to 11 days after application, indicating that a claim that PB increases the persistence of pyrethrins is unjustified.

A formula was developed to express the approximate pyrethrin equivalent of mixtures of pyrethrins and PB applied in films against *Tribolium*, but was found to be inapplicable to mixtures applied as direct sprays, or to other insects as films ; 0·4 per cent. pyrethrins with 2·5 per cent. PB was considerably less toxic to *Tribolium* as a spray than 1·3 per cent. pyrethrins alone, but more toxic to *C. granaria* as a film than 1·4 per cent. pyrethrins.

LATIF (A.) & YUNUS (C. M.). **Food-plants of Citrus Leaf-miner** (*Phyllocnistis citrella* **Stn.) in the Punjab.**—*Bull. ent. Res.* **42** pt. 2 pp. 311–316, 8 refs. London, 1951.

Phyllocnistis citrella Staint., which mines the leaves of *Citrus* in the Punjab (Pakistan), has been recorded in different parts of the world on food-plants belonging to five widely separated families. Since the authenticity of some of

these records was doubted, observations were made at Lyallpur and elsewhere in the Province to determine its true food-plants there, and these were supplemented by rearing experiments on plants of 17 species other than *Citrus*, including some of the recorded food-plants. *P. citrella* was found to complete its development on ten species and forms of *Citrus* and on *Aegle marmelos* in the field, but infestation of *A. marmelos* was negligible. Of the species of *Citrus*, elephant lemon (*C. medica*), which has succulent leaves, was the most, and lime (*C. aurantiifolia*), which has thick and coarse leaves, the least susceptible to attack. It is recommended that *C. medica*, which is the species of least economic importance, should be excluded from *Citrus* orchards, and that a variety of lemon (*C. limonia*) commonly used as a hedge plant should not be grown round them. In the experiments, eggs were laid on *A. marmelos*, willow (*Salix* sp.), *Murraya exotica*, *M. koenigii*, grape vine, *Dalbergia sissoo*, *Jasminum sambac*, *Jasminum* sp. and *Grewia asiatica* ; a few larval mines were formed on the first three, but pupae and adults developed only on *A. marmelos*.

WAY (M. J.), SMITH (P. M.) & HOPKINS (B.). **The Selection and Rearing of leaf-eating Insects for Use as Test Subjects in the Study of Insecticides.**—*Bull. ent. Res.* **42** pt. 2 pp. 331–354, 1 pl., 1 fig., 32 refs. London, 1951.

An account is given of investigations in England on the suitability of various leaf-eating insects for mass rearing in the laboratory to provide stocks for insecticide studies. In addition to descriptions of the rearing techniques developed, the paper includes the results of experiments on the conditions necessary to maintain healthy stocks of uniform resistance, in which the effects of food-plant, temperature, humidity and illumination were tested, and the relation of some of these factors to diapause. *Plutella maculipennis* (Curt.), *Diataraxia oleracea* (L.), *Autographa* (*Plusia*) *gamma* (L.) and *Phaedon cochleariae* (F.) proved suitable for rearing throughout the year. *Mamestra brassicae* (L.), *Sphinx ligustri* L., *Lymantria dispar* (L.) and *Pieris brassicae* (L.) can sometimes be reared in large numbers, but were less satisfactory, the first three because of obligate diapause, *L. dispar* also because of the lack of suitable foliage in winter, and *P. brassicae* because it does not pair or oviposit readily in the laboratory. *Mesographe forficalis* (L.), *Xanthorhoë fluctuata* (L.), *Lema melanopa* (L.) and *Crioceris asparagi* (L.) were reared in small numbers, and though they possess some disadvantages, they would probably prove satisfactory during some part of the year. Laboratory rearing of *Phlogophora meticulosa* (L.), *Agrotis segetum* (Schiff.), *Triphaena pronuba* (L.), *Silpha* (*Aclypea*) *opaca* L. and *Athalia rosae* (L.) (*colibri* (Christ)) was attempted but is considered impracticable.

TALHOUK (A. S.). **The Effect of Parathion Dusts on *Eurygaster integriceps* Put. (Hem.).**—*Bull. ent. Res.* **42** pt. 2 pp. 375–377, 3 refs. London, 1951.

Eurygaster integriceps Put. is a serious pest of wheat in Syria, where the collection and destruction of the overwintering adults, eggs and spring nymphs and of the leaves of the weed, *Leontice leontopetalum*, on which the bugs oviposit, have been the only measures available against it. The scarcity of water in the infested areas precludes the use of sprays [*cf. R.A.E.*, A **33** 303], and dusts of benzene hexachloride proved unsatisfactory in field and laboratory tests. In 1950, however, dusts containing 0·8 or 0·75 per cent. parathion gave very promising results in the laboratory and were therefore tested in the field. When applied to small plots at about 67·5 lb. per acre in May, both dusts gave effective but uneconomic control, and when larger plots were dusted by means

of a knapsack duster at 13·5–15·75 lb. per acre, infestation was reduced by about 20 per cent. In a test in June, in which wheat over more than two acres was dusted with 0·75 per cent. parathion at about 43 lb. per acre by means of power equipment mounted on a jeep fitted with a drag-sheet, 70 per cent. reduction was obtained.

BOX (H. E.). **New Species and Records of *Diatraea* Guild. from northern Venezuela (Lepid., Pyral.).**—*Bull. ent. Res.* **42** pt. 2 pp. 379–398, 1 pl., 5 figs., 16 refs. London, 1951.

Records are given of the local distribution (with altitudes) and habitats of 11 species of *Diatraea* reared from known food-plants in northern Venezuela ; three of them, all from wild grasses, are described as new. Those that attack sugar-cane [*cf. R.A.E.*, A **39** 93] include *D. rosa* Heinr., which was hitherto considered a subspecies of *D. busckella* Dyar & Heinr., but is here raised to specific rank ; it is stated to be the most important of the sugar-cane borers of Venezuela, to which country it appears to be confined. *D. busckella* is regarded as a polytypic species, comprising the typical subsp. *busckella* and one described as *D. b. setariae*, subsp. n., which is restricted to wild grasses. *D. b. busckella* exists in a number of forms, of which three are well-defined ; these are the typical *busckella*, which attacks sugar-cane in western Venezuela and Colombia and was described from Panama, and two described as new, of which *falconensis* attacks sugar-cane in Venezuela, but is confined to a few isolated farms in the extreme north, and *setariaeoides* is restricted to a wild grass. The genitalia of *D. rosa* and *D. busckella*, which together are regarded as forming a supraspecies, are illustrated, and their diagnostic characters and the relation of the various subspecies and forms of *D. busckella* to each other and to *D. rosa* are discussed. A few adults (all males) were reared from eggs laid by females of *D. rosa* that paired with males of *D. b. busckella* in the laboratory. Fertile eggs were also laid by females of *D. b. busckella* that paired with males of *D. rosa* and *D. b. setariae* and by females of *D. b. setariae* that paired with males of *D. rosa*, but larval mortality was high, and no adults had been reared at the time of writing.

PRADHAN (S.) & BHATIA (S. C.). **Specific Susceptibility to HCN and the Amount of HCN recovered from fumigated Insects.**—*Bull. ent. Res.* **42** pt. 2 pp. 399–418, 9 figs., 15 refs. London, 1951.

An account is given of experiments carried out to investigate the relation between the susceptibility of insects to fumigation with hydrocyanic acid gas and the amount of HCN recoverable from them immediately after fumigation. The test insects were adults of *Tribolium castaneum* (Hbst.), first- and second-instar nymphs, third- and fourth-instar nymphs and adult females of *Drosicha* sp. and seventh-instar larvae of *Corcyra cephalonica* (Staint.), the exposure period was 30 minutes and the fumigant was recovered by the distillation method of Sinclair & Ramsey [*R.A.E.*, A **34** 150] ; all techniques are described. The following is based on the authors' summary. A preliminary experiment showed that the results obtained by the distillation method were valid and confirmed the finding [*loc. cit.*] that a reducing substance that was given out by *T. castaneum* and affected the results of distillation could be eliminated by redistillation. When the insects were exposed to various concentrations of HCN, the order of decreasing susceptibility was first- and second-instar *Drosicha* nymphs, third- and fourth-instar *Drosicha* nymphs, *C. cephalonica*, *T. castaneum*, and *Drosicha* adults ; the greatest amounts of HCN per 100 gm. body weight were recovered from *C. cephalonica*, followed in descending order

by first- and second-instar *Drosicha* nymphs, *T. castaneum*, third- and fourth-instar *Drosicha* nymphs and *Drosicha* adults. When the insects were exposed to concentrations greatly exceeding those required for complete mortality, the order of descending recovery of HCN was similar, but the positions of *T. castaneum* and the third- and fourth-instar *Drosicha* nymphs were reversed. Less HCN was recovered from examples of *T. castaneum* and *C. cephalonica* that survived fumigation than from those in the same batches that did not. The amounts of HCN sorbed by *Drosicha* adults and *Corcyra* larvae exceeded those subsequently recovered from them, and the amounts sorbed per gm. body weight and those converted into a non-recoverable state were much less in *Drosicha* adults than in *Corcyra* larvae under similar conditions of fumigation. A comparison of *Tribolium* and *Drosicha* adults and *Corcyra* larvae indicated that their water contents were positively correlated with both susceptibility to HCN and amount of HCN recoverable after fumigation ; it is suggested that water content may be a factor in the surface resistance of the insect to the entry of a fumigant. Observations by other workers that larger amounts of fumigant are sorbed by or recovered from susceptible than less susceptible species [**26** 567 ; **34** 150] were confirmed by experiments with *C. cephalonica*, *T. castaneum* and adults, but not nymphs, of *Drosicha*.

When dosage-mortality graphs were prepared by taking the amount of HCN recovered per gm. body weight as an index of internal dose, the order of resistance of the test insects was found to be entirely different from that based on the concentrations to which they were exposed. These apparently anomalous observations can be explained by regarding the total effective resistance shown by an insect to the concentration of HCN to which it is exposed (external dose) as the resultant of the surface resistance to the entry of the fumigant and the internal resistance to the HCN that enters the body (internal dose). The effective resistance of *C. cephalonica* was low as a result of low surface resistance despite high internal resistance, and that of the *Drosicha* adults high, as a result of high surface resistance despite low internal resistance.

HOWE (R. W.). **Studies on Beetles of the Family Ptinidae. 4. A Note on an anomalous Effect of parental Age on the Speed of Development.**—*Ent. mon. Mag.* **86** pp. 325–326, 3 refs. London, 1950. **V. The Oviposition Rate of *Ptinus tectus* Boield. under natural Conditions.**—*Bull. ent. Res.* **42** pt. 2 pp. 445–453, 1 fig., 6 refs. London, 1951.

In the first of these two parts of a series [*cf. R.A.E.*, A **38** 477], it is stated that the mean duration of development of larvae from eggs laid by five fertilised females of *Ptinus tectus* Boield. during the first ten days of oviposition increased, except for one day, with each successive day of egg-laying. There was no change in temperature or humidity to account for this, and it was not dependent on the type of food supplied to the larvae. Records for larvae from other isolated pairs showed few marked trends in rate of development, but the first egg laid was generally abnormal, usually developing more slowly than the average. Larvae from eggs laid by females of *Gibbium psylloides* (Czenp.) developed significantly faster than those from eggs laid by the same females one month previously when kept at 20°C. [68°F.] and 70 per cent. relative humidity in tubes of food.

The following is virtually the author's summary of the second part. An account is given of an attempt to estimate changes in the rate of egg-laying by *P. tectus* in a warehouse in Buckinghamshire [**38** 478] from May 1945 to October 1946 and in an unheated outbuilding at the laboratory (to which some of the experimental bags [*loc. cit.*] were transferred) from January 1947 to March 1948. Small samples of foods of vegetable and animal origin were

placed on pieces of newspaper on the floor, and were renewed regularly, weekly or fortnightly in the warehouse and daily at the laboratory. Larvae were bred from these food samples and counted. The rate of oviposition was found to depend on temperature, especially in winter, and on relative humidity, especially in summer. It was seldom cold enough indoors, in unheated premises, to prevent oviposition entirely for more than a few days at a time, 5°C. [41°F.] being the approximate minimum temperature for oviposition. It was never so dry at the laboratory that egg-laying stopped, but this did happen at the warehouse in July 1946. Free drinking water is necessary for continued oviposition, and this was available from rain in both buildings. Darkness causes an increase in activity and in oviposition, and most of the eggs in the foods supplied were laid at night. Foods placed near the daytime hiding places of adults were most used for oviposition. When a choice of food was given, the numbers of eggs laid in each varied considerably, flour attracting few eggs and fishmeal and cottonseed meal many.

WILLIAMS (J. R.). **The Control of the Black Sage in Mauritius by** *Schematiza cordiae* **Barb. (Col., Galerucid.).**—*Bull. ent. Res.* **42** pt. 2 pp. 455–463, 2 pls., 13 refs. London, 1951.

Consignments of *Schematiza cordiae* Barber were sent by air from Trinidad to Mauritius in June–September 1947, with a view to the establishment of this Galerucid for the control of the noxious weed, *Cordia macrostachya* [*cf. R.A.E.*, A **38** 344], but only 500 living adults were obtained from the 15,000 larvae and prepupae despatched. Stocks were reared in the laboratory by a technique that is described. The results of feeding tests in which larvae were confined in petri dishes with leaves of 86 plants in many different families confirmed those of tests in Trinidad [**38** 343], and it was concluded that the beetles could be released without risk to plants unrelated to *C. macrostachya*. In the laboratory, the adults survived for 3–8 weeks and the females laid an average of 750 eggs each in summer (November–April) and about half this number in winter. Under field conditions, development from egg to adult lasted 20–50 days according to season and climate. Both larvae and adults sometimes fed on the unripe fruits, destroying the seeds if the endocarp was still soft, and on the outer tissue of the peduncles, causing many inflorescences to fall; such feeding was most frequent when the foliage was not plentiful. Newly hatched larvae completed their development on inflorescences alone, but mortality was high and the resulting adults small. During June–December, when the climate is dry, few eggs were laid, development was prolonged, and the adults were less in evidence, though they fed to some extent [*cf.* **33** 343]. This inactivity is most pronounced in the dry climates at the lower altitudes, and probably amounts to complete quiescence in some coastal areas, where there is severe drought during winter. The food-plant is also affected by drought and loses its foliage completely where the winter is very dry, but only partly in the sheltered uplands.

Adults were first liberated in March 1948, and since they almost immediately became quiescent, little defoliation occurred until the end of the year, when numbers began to increase rapidly. Breeding was continued in the laboratory until February 1949, when about 18,000 adults had been released in 18 localities representing a wide range of environmental conditions, but was then discontinued, since large populations had developed at many liberation sites. Between February and April, about 60,000 adults were collected in the field for redistribution, and towards the end of the year, the beetles had spread over almost all the island and were causing severe injury to the weed almost everywhere. Bushes over extensive areas, especially in the north-east and

east, were stripped of leaves, flowers and fruits, and many had been in this condition for about six months. The beetles were less numerous in 1950, presumably owing to a shortage of food, except in the south and south-west, where they had caused less defoliation in 1949 ; they were still sufficiently numerous to suppress new growth, however, and most dense scrub was denuded or heavily defoliated by the middle of the year, though scattered bushes were less severely attacked. Bushes that have been denuded die back gradually from the tips of their branches provided that new foliage is prevented from developing, and those less than 4 ft. high were usually killed within a year. Bushes that are dead or nearly dead have sometimes been used for firewood, and stripped bushes have sometimes been smothered by climbing plants that had hitherto been suppressed. Cutting back the bushes now usually controls them, since the beetles prevent rejuvenation. Furthermore, seed production, to which the aggressiveness of *Cordia* is due, is greatly reduced as a result of defoliation [*cf.* **36** 424 ; **39** 280].

No cultivated plants were attacked in the field by the beetle, which completed its development only on *C. macrostachya*, though adults fed and oviposited on *C. abyssinica*, chiefly seedlings and young plants, which were sometimes defoliated, and *C. myxa*. No parasites were reared from the eggs or larvae, and the only predator observed was *Afrius williamsi* Miller [**39** 408], of which adults and nymphs of all instars except the first attack the larvae and adults. This Pentatomid is polyphagous, but on *Cordia* was observed to prey only on *S. cordiae* ; it is not considered likely to inhibit the usefulness of the beetle.

Although good control of *Cordia* is now assured, the investigation of other beneficial insects from the West Indies is being continued, and in 1950, colonies of an unidentified seed-infesting species of *Eurytoma* closely related to *E. howardii* D.T. were established.

China (W. E.) & Carvalho (J. C. M.). **Four new Species representing two new Genera of Bryocorinae associated with Cacao in New Britain (Hemiptera, Miridae).**—*Bull. ent. Res.* **42** pt. 2 pp. 465–471, 4 figs., 1 ref. London, 1951.

The new genera described are *Pseudodoniella* and *Parabryocoropsis*, and the new species are *Pseudodoniella pacifica*, *Parabryocoropsis typicus*, *P. duni* and *P. cheesmanae*. The first three were found damaging cacao in New Britain in 1950, and *P. cheesmanae* was taken in Papua in 1933, its food-plant being probably also cacao.

Burnett (G. F.). **Observations on the Life-history of the Red Locust, *Nomadacris septemfasciata* (Serv.) in the Solitary Phase.**—*Bull. ent. Res.* **42** pt. 2 pp. 473–490, 5 figs., 22 refs. London, 1951.

The following is substantially the author's summary of observations on *Nomadacris septemfasciata* (Serv.) made between June 1948 and May 1949 in the Milepa centre of the Rukwa outbreak area in Tanganyika Territory. The populations described were all in or near the solitary phase. Sexual maturation as measured by the developing ovaries took place rapidly though irregularly through the population. Its onset coincided with an increase in the daily number of hours of relative humidity at or above 75 per cent. and the abundance of green food. Pairing, which began after the first widespread rain, took place before the ovaries of many females were completely mature. Caged locusts gave a mean fecundity of 183 eggs contained in 2·4 pods, which is probably a minimum figure. Pods were laid at intervals of about two weeks,

and each was laid before the next batch had visibly developed. The period spent in the egg was not less than 39 or more than 46 days and was probably 42 days. Adults appeared 67 days after the eggs first hatched. Both these periods are longer than those recorded for phase *transiens* or *gregaria*. Locusts in phase *solitaria* were found to pass through seven nymphal instars, as compared with six for phase *gregaria*, and this difference seemed to be constant. The extra instar was probably interpolated between those representing the second and third of phase *gregaria*, but was not an exact duplicate of any other instar. The number of vertical dark eye-stripes is a convenient and fairly constant indicator of instar. The number of antennal segments in the later instars and in the adult, and also the number of eye-stripes in the adult, is greater in phase *solitaria*. Amongst the hoppers, three main types of coloration were encountered and are briefly described, but they could not be closely related to phase. The amount of dark pigment present in late-instar nymphs was reflected in the young adult, the appearance of which is described in some detail. Subsequent changes during the dry season are briefly noted, in particular the pink of the hind wing, which becomes faintly visible within a month of the last moult. The changes in pigmentation that take place during sexual maturation are described. In addition to pronounced darkening of the tegmina, which completely changes the appearance of the *solitaria* locust, certain bright pigments are laid down but are later obscured by a general blackening. It is unsafe to classify *N. septemfasciata* as to phase on colour alone unless the date of capture and its relation to the breeding season in the locality are taken into consideration. Locusts in phase *solitaria* do not normally develop the general reddening of the body shown by migrating swarms, even when these are only in phase *transiens*.

JACOBSON (M.). **Herculin, a pungent insecticidal Constituent of Southern Prickly Ash Bark.**—*J. Amer. chem. Soc.* **70** pp. 4234–4237, refs. Easton, Pa., 1948. **The Structure of Pellitorine.**—*Op. cit.* **71** pp. 366–367, 10 refs. 1949. **Constituents of *Heliopsis* Species. I. Scabrin, an insecticidal Amide from the Roots of *H. scabra* Dunal.**—*Op. cit.* **73** pp. 100–103, 1 graph, 10 refs. 1951.

In these papers, the author describes investigations on the structure of herculin, which was isolated from the bark of *Zanthoxylum clava-herculis* and shown to be N-isobutyl-2,8-dodecadienamide, pellitorine, which was isolated from the roots of *Anacyclus pyrethrum* and shown to be N-isobutyl-2,6-decadienamide, and scabrin, which was isolated from the roots of *Heliopsis scabra* and shown to be the N-isobutylamide of an isomer or mixture of isomers of octadecapentaenoic acid. Comparison against *Musca domestica* L. showed that herculin had approximately the same order of paralysing action and toxicity as pyrethrins and that pellitorine was as effective in paralysing action and rather more than half as toxic and scabrin appreciably more toxic than pyrethrins at the same concentration. Herculin was also toxic to mosquito larvae, ticks, several leaf-eating insects and the eggs of the body louse [*Pediculus humanus humanus* L.].

DOWNING (R. C.). **Aerosols. A two part Study of Stability Tests of Low Pressure Formulations and Solubility of various old and new Insecticides in Propellents and auxiliary Solvents.**—*Soap & sanit. Chem.* **26** no. 7 pp. 114–115, 117, 119, 139, 4 graphs, 6 refs. New York, N.Y., 1950.

In the first part of this paper, the author gives the results of tests on the stability of low-pressure aerosol mixtures. Stable mixtures are those that

suffer little or no decomposition or discoloration and cause little corrosion of metals The propellent for low pressure aerosols is usually a combination of a low-boiling liquefied gas and a higher boiling component, and the effect on stability of two of the most effective of these, mixtures of Freon-12 [dichlorodifluoromethane] with Freon-11 [trichlorofluoromethane] or methylene chloride [*cf. R.A.E.*, A **38** 490], was tested by observation of the aerosol solution and by calculation of the corrosion rate for an exposed metal test piece sealed in a glass tube containing the test mixture and stored at 150 or 250°F. The higher temperature was used to accelerate decomposition and corrosion. Steel and tin plate were exposed in mixtures of 3 per cent. pyrethrum extract (20 per cent. pyrethrins in oil), 2 per cent. DDT and 95 per cent. propellent, the latter consisting of Freon-12 with 34 or 59 per cent. Freon-11 or 39 or 68 per cent. methylene chloride. This formula is essentially anhydrous, and conclusions based on tests using it may not apply to aqueous systems. In all tests, decomposition of the liquid was much more extensive and metal corrosion was more rapid, though in some cases the differences were not great, with methylene chloride than with Freon-11. Formulae containing 68 per cent. methylene chloride caused somewhat greater corrosion than those containing 39 per cent., but there was no appreciable difference in corrosion between 59 or 34 per cent. Freon-11. Corrosion was probably less at 150°F. than at 250°F., though no strict comparison could be made, as the periods of treatment were different, but changes in the appearance of the liquid seemed independent of the temperature or concentration of Freon-11 or methylene chloride. There was little difference in corrosion between steel and tin plate, though steel seemed to be slightly less affected. It is concluded that formulations containing methylene chloride corrode both steel and tin plate more than those containing Freon-11, and that decomposition or interaction of the organic materials is more severe and occurs earlier in the former.

In the second part, the author discusses the solubility of various insecticides, particularly methoxy-DDT (methoxychlor), in propellents and auxiliary solvents at temperatures ranging from −4 to 90°F. Determinations involving liquefied gases were made in a special glass container, and solubility was measured by observing the solution temperature for a given amount of solid or by filtering a saturated solution from the container into a trap, evaporating the solvent and weighing the residue ; a comparison of the infra-red absorptions of methoxy-DDT and the residue showed that there was little or no preferential extraction of impurities by the solvent. The result from the filtration method was usually checked by determining the solution temperature of a given amount of insecticide in the prescribed amount of solvent. Tests showed that in a mixture of Freon-12 and Freon-11 (1 : 1), the solubility of DDT was 4·3 gm. per 100 gm. solvent at 90°F. and 1·4 gm. at 30° and that of methoxy-DDT nearly 5·2 gm. per 100 gm. at 90°, about 1·5 gm. at 30° and about 1 gm. at 0°F. The compounds were about equally soluble in Freon-12, but methoxy-DDT was appreciably more soluble in Freon-11. The solubility of methoxy-DDT was quite high in methylene chloride and in mixtures of this with Freon-12, ranging for a 1 : 1 mixture from about 21 gm. per 100 gm. solvent at 0°F. to 77 gm. at 70°.

Further tests showed that the solubility of DDT in various liquefied chlorofluoromethanes and chlorofluoroethanes decreased as the fluorine content of the molecule increased and reached a very low level for highly fluorinated materials. The substitution of hydrogen for chlorine caused a considerable increase in the solvent power when one fluorine atom was present in the methane molecule and only a slight increase when two fluorine atoms were present. The solubility of DDT and methoxy-DDT in a commercial alkylated naphthalene solvent (Sovacide 544-C) decreased rapidly from 53 and 50 gm. per 100 gm. solvent to 1·4 and 1 gm. per 100 gm. as the temperature fell from

77 to −13°F. Methoxy-DDT was about twice as soluble as DDT in methylene chloride and Freon-11, and 50 per cent. butyl carbitol thiocyanate in petroleum distillate and chlordan were miscible with both solvents at a temperature of 32°F. The thiocyanate preparation was miscible with Freon-12 at 32°, and chlordan had a solubility of 30 gm. per 100 gm. in Freon-12 at 72°F. The solubility in Freon-11 and methylene chloride was more than adequate for the formation of insecticidal aerosol sprays in all cases and generally greater in methylene chloride than in Freon-11.

RIEMSCHNEIDER (R.). **Zur Kenntnis der Kontakt-Insektizide II.** [Contribution to Knowledge of Contact Insecticides II.]—*Pharmazie* Beih. **9** Ergänzungsbd. **1** pp. [2+] 649–800, 19 figs., 11 pp. refs. Berlin, 1950.

Über Kontakt-Insektizide. [On Contact Insecticides.]—*Pharm. Zentralh.* **87** no. 5 pp. 132–134, 3 refs. Dresden, 1948.

The first of these publications on the chemistry and toxicology of halogenated-hydrocarbon insecticides completes an earlier paper [*R.A.E.*, A **37** 481] and is based largely on the world literature, though it includes the results of some unpublished investigations by the author and his colleagues in Germany. It is divided into two main parts, dealing respectively with materials of the groups of DDT and DDD (α,α-bis(4-chlorophenyl)-β,β-dichloroethane) and of the group of BHC (benzene hexachloride), in which chlordan (M 410) is included. The chlordan was of German manufacture and was evolved in 1945 as a result of a study of substances analogous to cantharidin.

The first part includes accounts of the development of DDT and DDD and analogues of them, methods of preparing DDT, DDD and fluoro-DDT (α,α-bis-(4-fluorophenyl)-β,β,β-trichloroethane), the composition of the technical products, and the chemical and physical properties of these materials and isomers and analogues of them, including solubility, stability to light, alkalis, metals and metal salts, and volatility. In connection with the last point, it is shown that the contact toxicity to *Melophagus ovinus* (L.) and *Drosophila melanogaster* Mg. of a series of DDT and DDD analogues was strongly reduced as their melting-points rose above about 150°C.

A section on toxicity to arthropods, largely insects, follows. In tests against various insects in Germany with isomers of DDT, fluoro-DDT and DDD, the order of decreasing effectiveness of the isomers was p,p′, m,p′, o,p′, o,m′ and o,o′. It is further shown that α-(4-chlorophenyl)-β,β,β-trichloroethanol and α-chloro-α-(4-chlorophenyl)-β,β,β-trichloroethane (two by-products in technical DDT) are highly toxic, and even more so against some insects than p,p′ DDT, but are unstable and volatile, and also that p,p′ fluoro-DDT is more toxic to many insects than p,p′ DDT, though less persistent. In tests against *M. ovinus* and *D. melanogaster*, various isomers of fluoro-DDT and fluoro-DDD were more toxic than the corresponding isomers of the chloro compounds.

Further sections in this part contain comparisons of the effectiveness of DDT with that of the older insecticides, data on the rapidity of action of mixtures of DDT with other materials, discussions of the ways in which DDT and DDD are used, the precautions to be taken in practical work and the toxicity of DDT, fluoro-DDT and DDD to warm-blooded animals, and brief reviews of various theories as to the mode of action of DDT and its analogues on insects, and of physical and biological methods of quantitative determination.

The second part contains accounts of the discovery of the toxicity of BHC, its various isomers and analogues of it, their chemical and physical properties, the preparation and composition of technical BHC, and the development of methods of separating its various isomers, increasing the γ content and freeing it from objectionable odour. Work on the toxicity of BHC and its isomers to

insects is reviewed. Experiments by the author confirmed the outstanding toxicity of the γ isomer and showed that the β isomer, which has a high melting-point, is practically non-toxic, the ε isomer almost always ineffective, and the α and δ isomers weakly toxic. In tests against *M. ovinus* and *D. melanogaster* with various isomers and analogues of BHC, monofluoro-hexachloro-cyclohexane was nearly as toxic as γ BHC to both insects, and the tri-, tetra-, penta- and hexachloro-methyl-isopropyl-cyclohexanes were fairly toxic to *M. ovinus*, in that order of decreasing effectiveness. Chlordan was moderately toxic and rapid in action against *D. melanogaster*, but less so than γ BHC or fluoro-DDT, and it proved more toxic to *Musca domestica* L. than DDT or DDD. The final sections deal with the use of BHC in pest control, its effect on bacteria, yeasts and plants, its toxicity to warm-blooded animals, theories as to its mode of action and methods of quantitative analysis of the γ isomer.

The second paper is a summary of the first.

RIEMSCHNEIDER (R.). **L'évolution du "1068", ou "M 410", ou "chlordane".**—*Chim. et Industr.* **64** no. 6 pp. 695–698, refs. Paris, 1950. **Vorläufige Mitteilung über neue Kontakt-Insektizide der Halogenkohlenwasserstoffklasse.** [Preliminary Communication on new Contact Insecticides of the Class of the Halogenated Hydrocarbons.]—*Pharmazie* **3** pt. 3 pp. 115–116, refs. Berlin, 1948.

In the first of these papers, the author compares the processes leading to the discovery of chlordan (M 410) in Germany [*cf.* preceding abstract] and in the United States and emphasises that work in the two countries proceeded independently. In the second, its development in Germany is also described, and it is stated that tests showed both it and a corresponding fluoro-chloro derivative (M 344) to possess high toxicity to insects.

RIEMSCHNEIDER (R.). **Über phosphorhaltige Insektizide.** [On Phosphorus-containing Insecticides.]—*Pharmazie* **3** pp. 506–509, refs. Berlin, 1948.

The author discusses methods of preparing HETP (hexaethyl tetraphosphate), describes distillation experiments showing that this material is a mixture of esters [*cf. R.A.E.*, A **37** 487], of which TEPP (tetraethyl pyrophosphate) and triethyl phosphate were identified, and gives the results of tests in which *Drosophila melanogaster* Mg. was exposed to residues of acetone solutions of various insecticides. The order of decreasing effectiveness of these was approximately γ benzene hexachloride, parathion, fluoro-DDT, chlordan (M 410), octachloroendomethylene-trimethyl-cyclohexane (M 414), TEPP, DDT, DDD and HETP. Tetrapropyl pyrophosphate [*cf.* **36** 228] was about as effective as TEPP.

RIEMSCHNEIDER (R.) & OTTMANN (G.). **Über das sogenannte "ζ-Hexachlorcyclohexan" II-III.** [On the so-called ζ-Hexachlorocyclohexane II–III.]—*Z. Naturf.* **5b** pts. 5–6 pp. 246–250, refs., 307–311, 1 graph, refs. Tübingen, 1950.

RIEMSCHNEIDER (R.). **Über das sogenannte "ζ-Hexachlor-cyclohexan" IV.**—*Op. cit.* **6b** pt. 1 pp. 48–49, refs. 1951. **Über das Hexachlorcyclohexan vom Schmp. 146°C. VI: Die Konfiguration des α-1.1.2.4.4.5-Hexachlor-cyclohexans.** [On the Hexachlorocyclohexane with a Melting-point of 146°C. VI: The Configuration of α-1,1,2,4,4,5-Hexachloro-cyclohexane.]—*T.c.* pt. 6 pp. 339–340, refs.

In these papers are recorded detailed investigations in Germany on the preparation and identity of a product of the chlorination of cyclohexane that

melts at 146°C. and has been claimed by O. Bastiansen and his colleagues (1947) to be a new stereoisomer (the so-called ζ isomer) of benzene hexachloride (1,2,3,4,5,6-hexachlorocyclohexane). It is shown in the third of them to be α-1,1,2,4,4,5-hexachlorocyclohexane and is stated in the first to have proved weakly toxic to *Drosophila melanogaster* Mg. in laboratory tests and practically non-toxic to some other insects.

RIEMSCHNEIDER (R.). **Über Carboxylverbindungen der Diarylalkane und -alkene II. β,β-Dichlor-α,α-bis-(4-carboxy-phenyl)-äthylen und verwandte Verbindungen.** [On Carboxyl Compounds of Diarylalkanes and -alkenes II. α,α-Bis(4-carboxyphenyl)-β,β-dichloroethylene and related Compounds.]—*Z. Naturf.* **6b** pt. 4 pp. 179–183, refs. Tübingen, 1951.

The preparation of α,α-bis(4-carboxyphenyl)-β,β-dichloroethylene and related compounds is described. In contact tests, none of these analogues of DDT showed any toxicity to *Drosophila melanogaster* Mg. or *Musca domestica* L.

RIEMSCHNEIDER (R.). **Über einige β,β,β-Trichlor-α-(dichlor-phenyl)-äthanole.** [On some α-(Dichlorophenyl)-β,β,β-trichloroethanols.]—*Monatsh. Chem.* **82** pt. 4 pp. 600–606, 12 refs. Vienna, 1951.

The author describes the preparation of various α-(dichlorophenyl)-β,β,β-trichloroethanols and states that α-(3,4-dichlorophenyl)-β,β,β-trichloroethanol showed toxicity when tested against several insects.

ROEGNER-AUST (S.). **Der Infektionsweg bei der Polyederepidemie der Nonne.** [The Mode of Infection with epidemic Polyhedral Disease in the Nun Moth.]—*Z. angew. Ent.* **31** pt. 1 pp. 3–37, 5 figs., 55 refs. Berlin, 1949.

The author reviews literature showing that polyhedral disease in insects is caused by a virus and discusses its possible means of spread. These have generally been held to be ingestion of infected food and contact with contaminated surfaces, but the outbreaks that occur in nature are too sudden to be explained by these ways alone. Transmission through the egg has generally been denied, but was further investigated by the author in Germany in 1942–45.

Polyhedral bodies were removed from living and dead pupae of the nun moth [*Lymantria monacha* (L.)], received mainly from Thuringia, and the silkworm, *Bombyx* [*mori* (L.)]. It was observed that, while small polyhedra were little affected by pressure, large ones were easily broken into fragments. Similar fragmented bodies were found to occur naturally in pupae and were produced artificially without pressure in 2–5 days by placing cleaned polyhedral crystals extracted from dead pupae of *L. monacha* in lymph in dishes or by injecting them into healthy pupae and prepupae of *L. monacha* and *B. mori*. This effect of the pupal lymph on the polyhedra is analogous to that of the stomach juices of the larva on ingested polyhedra and permits the organs of the adults, including those of reproduction, to become infected. When the adult organs were stained and examined, polyhedral fragments were seen in the fat tissue and small nuclei in the end cells of the ovaries, although it was impossible to identify the latter with certainty.

Adults of *L. monacha* from laboratory and field stocks showing a high incidence of polyhedral disease were isolated in sterilised containers and the females allowed to oviposit on wire gauze under conditions preventing external infection of the eggs. These were later dissected, some of them after no treatment, some after surface sterilisation by immersion for two minutes in calcium hydroxide and some after sterilisation followed by cold storage for a year,

during which they died, and examined for evidence of polyhedral bodies. Well-developed polyhedra were found in 1·3 and small ones in 0·98 per cent. of them, all the eggs found positive coming from the last two groups. This confirmed that developed polyhedral bodies are not normally to be found in the eggs, but indicated that the elementary forms can be transmitted from adult to egg, the crystals usually not developing until after hatching. Bacteria were present in eggs from all batches. Further studies showed that before the crystals are formed, infective nuclei appear in the embryos as refracting bands encircling the haemolymph-cells. Eggs obtained in the laboratory under the conditions described were kept from February to November 1944 at 2°C. [35·6°F.] and the embryos dissected. Lymph was removed from each in a drop of water and the embryos were then crushed ; microscopic examination showed lymph cells surrounded by refracting bands in almost all of them and small polyhedra in some. Similar observations were made on *B. mori*, and it is concluded that a mode of transmission is demonstrated that accounts for the violent outbreaks observed in nature.

Since outbreaks among silkworms are harmful, methods of disinfecting insect eggs were tested. Of the larvae that hatched from two lots of eggs of *L. monacha* that were immersed for 15 minutes in 30 per cent. trichloroacetic acid, 28·1 and 32 per cent. died from polyhedral disease, as compared with 22·8 and 43·7 per cent. in the controls. Calcium hydroxide proved equally ineffective. Eggs from infected stock were examined on the surface and no polyhedral bodies were found, yet over 50 per cent. of the larvae that hatched from them died of polyhedral disease. Some strains of silkworms are known to be resistant to the disease, but affected lymph cells or small polyhedral crystals were found in 80 per cent. of one batch from stock that had been apparently free from the disease since 1938. Larvae from this stock completed their development and the adults reproduced normally. When fed on contaminated food, 50 per cent. of them died, and 85 per cent. of the survivors harboured infective forms. It is concluded that in such stocks, the disease is passed in a latent form from generation to generation.

Under suitable climatic conditions the disease becomes epidemic [*cf. R.A.E.*, A **35** 236], and it should be possible by controlling the temperature to prevent fatal outbreaks among silkworms. The prospects of spreading polyhedral disease artificially among larvae of *L. monacha* in the field are not promising, but laboratory rearing of larvae in winter, before hatching occurs in the field, will indicate the likelihood of an outbreak and the necessity or otherwise of chemical control.

FIEDLER (H. G.). **Biologie und Bekämpfung der Kaffeeminiermotten Ostafrikas unter Berücksichtigung des Klimas.** [Biology and Control of the Coffee Leaf-miners of East Africa with Reference to Climate.]—*Z. angew. Ent.* **31** pt. 1 pp. 38–76, 8 figs., 10 refs. Berlin, 1949.

Descriptions are given of all stages of *Leucoptera caffeina* Wshbn. and *L. coffeella* (Guér.), which are among the most important leaf-feeding pests of coffee in Tanganyika Territory, together with an account of field observations on their bionomics carried out mainly in the Kilimanjaro area. Small cages of gauze and glass were used to enclose twigs and infested leaves on the plants. The life-histories of the two species were similar [*cf. R.A.E.*, A **37** 111], but *L. caffeina* sought high humidity and shade, and the females laid their eggs on mature leaves in chains of 2–12, usually 5–8, whereas *L. coffeella* preferred a sunny situation and laid its eggs singly. Larvae of both species entered directly into the leaves from the eggs and fed on the palisade layer. Those of *L. caffeina* normally remained in groups during most of their feeding period and consumed on the average over three times as much as larvae of *L. coffeella*.

Larvae that hatched from eggs laid on the undersides of the leaves were unable to reach the palisade layer and died. Larval development was completed within a single leaf. When the food supply failed, owing to shedding and withering of the leaf or heavy infestation, the larvae either died or gave rise to undersized adults. If the leaves attacked had a low sap content or were only three-quarters grown, the larvae fed more voraciously and developed more rapidly, and when the leaves were rich in sap, calluses formed in the mines made by the larvae of *L. caffeina*. When these calluses grew more quickly than the leaf tissues were consumed, the larvae were drowned in the juices. Larvae of both species left their mines when full-fed and sought leaves in the shade on which to spin their cocoons. The adults paired on the day of emergence, and oviposition took place during the next two days. The adults survived for about six days in the warm months and for up to 12 days during the cooler weather [but *cf. loc. cit.*]. Females of *L. caffeina* laid 24–78 eggs. A table is given showing the duration of the life-cycle of this species in the field at the average temperatures encountered between February and May 1939. The egg, larval and pupal stages lasted 8–10, 20–21 and 10–11 days, respectively, at an average of 19·8°C. [67·64°F.] and 7, 11 and 8–9 days, respectively, at 24°C. [75·2°F.]. It is calculated by the use of Blunck's formula [**13** 389] that in the area of observation, where the average yearly temperature is 20·77°C. [69·39°F.], complete development requires an average of 38 days, so that there may be 9·6 generations a year.

The commonest parasite of *L. caffeina* observed was *Pleurotropis coffeicola* Ferrière [*cf.* **37** 112], which was present throughout the year. The adults of this Eulophid emerged when the host larvae were hatching and attacked those up to three days old. The life-cycle of both host and parasite lasted the same time. Parasitised larvae continued to feed but died without pupating, when the parasites left them and pupated in the leaf mines. Parasitism was particularly high during hot, dry weather and was then sufficient to suppress local outbreaks rapidly. An example is given from a plantation in Uru, where an outbreak that began in August was controlled by the end of November and the plants had recovered by the following February. The possibilities of control by means of sprays are discussed. Nicotine sulphate added to the fungicidal spray of bordeaux mixture is sometimes effective [*cf.* **27** 126], but spraying whole plantations is not satisfactory since both larvae and cocoons are well protected and parasites are killed. It is suggested that sprays should be confined to small areas to check incipient outbreaks and should be applied when the eggs or adults are present or the larvae are seeking their pupation sites.

GÖSSWALD (K.). **Methoden der Prüfung von Textilien auf Termitenfestigkeit im fabrikneuen und im Gebrauchszustand.** [Methods for testing Textiles in a new and used Condition for Resistance to Termites.]—*Z. angew. Ent.* **31** pt. 1 pp. 99–134, 20 figs., 28 refs. Berlin, 1949.

In experiments in Germany in 1943, carried out with a view to developing a standard method for testing fabrics and proofing treatments applied to them for resistance to termites, samples of various textiles were placed singly in closed dishes with 20 immature examples of *Kalotermes* (*Calotermes*) *flavicollis* (F.) and kept for two weeks at 27°C. [80·6°F.] and 98–99 per cent. relative humidity. The samples were examined daily for signs of damage and any weak or dead termites replaced by healthy ones. It was found that wool, cotton and fully synthetic materials with a polyvinyl-chloride base were the least damaged and viscose materials and raw silk the most. Finishing processes affected the degree of attack. Thus, the resistance of cotton was reduced by bleaching, and that of bleached cotton by mercerising ; satin was less injured

than other silks and flannel less than woollen cashmere. In tests of chemicals for proofing against termites, the cloth used should be the least resistant of its kind, while in tests of textiles claimed to be inherently resistant, the standard should be the most resistant.

Cloth in use in the tropics is subject to the influences of damp heat and rainfall and may become soiled with materials that are attractive to termites. To evaluate these factors, pieces of fabric were stored for a fortnight at 35°C. [95°F.] at a relative humidity of 99 per cent., kept for the same period at 25°C. [77°F.] in distilled water, or artificially soiled by impregnation with a 1 : 20 suspension of diastase in water [*cf. R.A.E.*, A **35** 333, etc.] before being tested, and some samples were washed and ironed up to 20 times. In some cases, samples that had been treated with various proprietary proofing agents were used. The results showed that the natural resistance of the textiles and the effectiveness of the chemicals varied widely following one or more of these treatments, so that it is not sufficient merely to test samples of cloth in the condition in which they leave the factory.

BECKER (G.). **Beiträge zur Ökologie der Hausbockkäfer-Larven.** [Contributions to the Ecology of the Larvae of *Hylotrupes bajulus*.]—*Z. angew. Ent.* **31** pt. 1 pp. 135–174, 8 figs., 44 refs. Berlin, 1949.

In the first of the investigations described, which were carried out in the laboratory in Germany, larvae of *Hylotrupes bajulus* (L.) of known weight were introduced into small blocks of pine sapwood, some of which had been impregnated with peptone. They were kept for 70 days at 97 per cent. relative humidity and either 28 or 30°C. [82·4 or 86°F.] and then re-weighed. The results showed that young larvae with initial weights of up to about 25 mg. increased their weight more quickly at the higher temperature and older ones at the lower. Older larvae kept at 20°C. [68°F.] showed percentage increases in weight that averaged 60 per cent. of those of larvae kept at 28°C., but this percentage rose to 110–130 when the temperature fluctuated gradually between 28 and 20°C. at intervals of 3 and 4, 5 and 2, or 7 and 7 days. Fluctuations within 24 hours, such as might be encountered in a building, were less favourable. Young larvae responded less to fluctuating temperatures than older ones. In experiments over ten months, a reduction in temperature and humidity for one week each month favoured larval development and reduced mortality. Other larvae were kept at 28°C. in pine blocks that had been dried and then allowed to absorb 24–82 per cent. of their weight of water. Since many of the larvae failed to bore into saturated wood, the higher quantities of water were added to the blocks about a fortnight after the larvae had entered them. A comparison of the increases in larval weight after 70 days at 28°C. showed that the rate of development was retarded at 35 per cent. water content, but increased to a peak at about 55 per cent. Development proceeded very slowly at 80 per cent. In two series, there was a minor peak at about 27–28 per cent. water content.

Measurement of individuals showed that there was no correlation between the length of females and the size of their eggs or the weight of the larvae from them after feeding for six months. Mortality was high among eggs incubated at 28°C. and 35 per cent. relative humidity, but after the larvae that hatched had fed for four months under favourable conditions, all were as heavy as the heaviest larvae from eggs kept at optimum humidity (97 per cent.). When first-instar larvae were placed between blocks of pine sapwood and pine heartwood or wood of deciduous trees, the pine sapwood was much preferred. Larvae survived for an average of 3–4 weeks at 20°C. without feeding if no suitable wood was available. Young larvae showed little geotactic reaction, but older ones exhibited marked negative geotaxis.

The literature on the nutritional value of albumin added to the wood is briefly reviewed [*cf. R.A.E.*, A **33** 18–19], and the results are given of experiments carried out at 28°C. and 97 per cent. relative humidity to test that of diastase and various proprietary preparations of peptone. The degree to which they promoted growth varied according to the age of the larvae, but the addition to the wood of 1·7 per cent. of its weight of peptones resulted in average increases in weight, after 70 days feeding, up to about 25 times as great as that in the controls. First-instar larvae that were fed for four months on wood impregnated with 1·2 per cent. of its weight of diastase showed a final weight equal to five times that of the controls ; the increase for the best of the peptones was 49 times. Glucose, brewers' yeast and vitamins B_1 and B_2 added to the peptone increased its effect in the order given, glucose being neutral or negative and vitamin B_2 doubling the rate of growth. Although larvae bred under optimum conditions quickly reached a sufficient size for pupation, most of them did not pupate until kept for several weeks at temperatures near freezing point. Under certain conditions, which are described, full-fed larvae and newly emerged adults were obtained in 6–12 months.

ROEGNER-AUST (S.). **Populationsanalytische Untersuchungen über die Sterblichkeit von Nonnenraupen.** [Investigations on Mortality of the Larvae of the Nun Moth for Population Analyses.]—*Z. angew. Ent.* **31** pt. 2 pp. 181–207, 5 figs., 18 refs. Berlin, 1949.

Predictions of the likelihood of outbreaks of the nun moth [*Lymantria monacha* (L.)] based on counts of pupal cases alone [*cf. R.A.E.*, A **35** 238] are not reliable because of variations in larval mortality, but mortality due to disease or constitutional weakness can be forecast by observing larvae reared from field-collected eggs in the laboratory before hatching begins in the field [*cf.* **40** 12], and in this paper the author shows by means of examples how population analyses of this kind should be made. Eggs were collected from various forest areas in Germany, mainly Thuringia, in the autumn, kept in cool storage until February and then transferred to optimum conditions for the hatching and development of the larvae [**27** 564]. Any dead larvae were removed each day, examined microscopically, and classified as dead owing to bacteria, polyhedral disease or physiological weakness. These data were plotted on graphs showing the percentage mortality from each cause on successive days and the cumulative mortality throughout the investigation, and the percentages of mortality in each larval instar are illustrated in diagrams. Since the larvae were reared under optimum conditions and the causes of mortality assessed were independent of external influences, mortality in the field might well be higher but could not be lower than that in the laboratory. When larval mortality was high, as in two of the examples given, in which it was 97·6 and 79·7 per cent., the outbreak was likely to collapse during the ensuing year, and when high mortality occurred among the young larvae, chemical control was considered unnecessary.

In an experiment to ascertain whether prolonged cool storage affected the results, eggs from a stock known to be fairly healthy were transferred to rearing conditions in February or July, and the mortality percentages for the resulting larvae were 8·8 and 98, respectively. In a similar test with eggs from an unhealthy source, the percentages of mortality caused by physiological weakness, bacteria and polyhedral disease were 0, 15·6 and 82, respectively, in February and 11·1, 25·6 and 59·9 in July. Prolonged cool storage thus had a detrimental effect, and it is concluded that the forecast should be made in early spring if the most accurate results are to be obtained.

ROEGNER-AUST (S.). **Einige Beobachtungen über die Wirkung von DDT- und Hexapräparaten auf Fische.** [Some Observations on the Influence of DDT and Benzene Hexachloride on Fish.]—*Z. angew. Ent.* **31** pt. 2 pp. 208–227, 10 refs. Berlin, 1949.

In view of uncertainty as to the effect on fish of applying DDT and BHC (benzene hexachloride) from aircraft against forest pests in Germany, experiments were carried out in which Gesarol (5 per cent. DDT) and BHC were tested on various fresh-water fish in aquaria. The results with BHC are to be reported separately. In the tests with DDT, the lowest concentration of Gesarol dust that caused complete mortality of any of the fish in static aerated water was 0·0019 per cent., which killed gudgeon in 48–154 hours. Dusting at the usual forest rates of 45–63 lb. Gesarol per acre would have produced this concentration in the aquarium, but since the depth of water was only 10·6 ins. and the percentage mortality fell steadily to 18 as the Gesarol concentration was reduced to 0·0001 per cent., it is considered that the danger to fish in lakes and ponds in treated areas is slight. Tests in running water showed that an initial concentration of 0·0025 per cent. Gesarol was soon dispersed and was harmless to the fish. An emulsified solution of DDT proved more toxic than the dust [*cf. R.A.E.*, A **35** 177], but gave the same general results.

FRANZ (J.). **Über die genetischen Grundlagen des Zusammenbruchs einer Massenvermehrung aus inneren Ursachen.** [On the genetic Reasons for the Collapse of an Outbreak from internal Causes.]—*Z. angew. Ent.* **31** pt. 2 pp. 228–260, 1 fig., 73 refs. Berlin, 1949.

The author points out from a review of the literature that outbreaks of insect pests often collapse not only through environmental but also through internal inherited factors. In normal years, mortality in the immature stages is high and only those individuals survive that are best adapted to the prevailing ecological conditions. Each individual has a different genetic make-up containing many characteristics unfavourable to the survival of the species, which are recessive and which constant cross-breeding normally prevents from becoming dominant. Under outbreak conditions, which imply a relaxation of rigorous natural selection, large colonies are built up from small nuclei and inbreeding becomes the rule rather than the exception. When this happens, the unfavourable recessive characteristics are strengthened and become more widespread with each succeeding inbred generation. Degeneration of the original stock sets in, and the mortality rate increases. Unless disease or other external causes (starvation through overpopulation, etc.) intervene, the outbreak collapses either with the reimposition of the selective forces or when the degeneration reaches a point at which almost all the offspring are unadapted to survive at some stage and succumb.

Numerous examples from the literature, chiefly on forest pests in Germany, are quoted to support this theory.

GÖTZ (B.). **Der Einfluss von Tageszeit und Witterung auf Ausschlüpfen, Begattung und Eiablage des Springwurmwicklers *Sparganothis pilleriana* Schiff.** [The Influence of Time of Day and Weather on Emergence, Pairing and Oviposition in *S. pilleriana*.]—*Z. angew. Ent.* **31** pt. 2 pp. 261–274, 10 figs., 12 refs. Berlin, 1949.

An account is given of investigations in a vineyard in south-western Germany in 1943–44 in which three modifications of a specially devised clock were used to record the times of day at which adults of *Sparganothis pilleriana* (Schiff.)

emerged from the pupae, the males were attracted to caged females, and the females oviposited. The results obtained in both years showed that emergence reached peaks at 8–9 a.m. and 8–9 p.m. and pairing and oviposition between 11 p.m. and 3 a.m. and 8 p.m. and midnight, respectively. Temperature and humidity were recorded, but their influence, if any, was unknown. The maximum and minimum temperatures and relative humidities at which activity was observed were 14 and 28°C. [57·2 and 82·4°F.] and 45 and 100 per cent.

BECKER (G.). **Bestimmung von Insektenfrassschäden an Nadelholz.** [Determination of Insect Damage to coniferous Wood.]—*Z. angew. Ent.* **31** pt. 2 pp. 275–303, 30 figs., 40 refs. Berlin, 1949.

A list is given of some 50 insect pests, chiefly Coleoptera, that damage timber from coniferous trees in Germany or other parts of central Europe, showing the types of injury caused, together with descriptions and illustrations of the various kinds of emergence holes, feeding galleries, pupal chambers, frass or excreta produced by them, from an examination of which the pests responsible can be identified.

FABER (W.). **Biologische Untersuchungen zur Diapause des Kartoffelkäfers (*Leptinotarsa decemlineata* Say).** [Biological Investigations on Diapause in *L. decemlineata*.]—*Pflanzenschutzberichte* **3** pt. 5–6 pp. 65–94, 3 graphs, 38 refs. Vienna, 1949. (With a Summary in English.)

The adults of *Leptinotarsa decemlineata* (Say) are known to enter a resting stage or diapause in the soil with the onset of cold weather in autumn, and sometimes also during favourable conditions in summer [*cf. R.A.E.*, A **33** 158], but the diapause does not occur in every generation. The beetles remain in diapause for a certain period whatever the external conditions, and if these are unfavourable, the true diapause is succeeded by a period of pseudo-diapause that lasts until favourable conditions return.

The investigations described in this paper were carried out in Vienna to elucidate the factors governing this diapause. The beetles used originated from outbreak areas in western Austria and were reared at 20–22°C. [68–71·6°F.] and 50–65 per cent. relative humidity throughout the year in the laboratory on potato. The behaviour of beetles about to enter diapause is described; these may be newly-emerged individuals that have just completed their maturation feeding, females that have begun oviposition or, more rarely, overwintered adults.

Among the offspring of females of which the oviposition period was interrupted by diapause, many completed maturation feeding and then went into diapause despite favourable external conditions [*cf.* **24** 13], and the proportions that did so varied considerably with individual egg-batches and with eggs laid before or after the female parent's diapause period. When beetles were reared from eggs laid before diapause by females of successive generations, the percentages that did not oviposit before diapause were about 10, 25, 50 and 100 in the offspring of the first, second, third and fourth generations. The females that oviposited immediately after maturation feeding developed a tendency for diapause that increased with the number of eggs laid and was apparently transmitted to the next generation, for the percentages that diapaused without ovipositing were 12 and 63 for females of the next generation from eggs laid early and late, respectively. The numbers of eggs laid by individual females before entering diapause decreased with each successive post-diapause generation. Inbreeding for three generations had no effect on the diapause tendency, but in the fourth inbred generation, which was a first post-diapause generation, the percentage that diapaused without

ovipositing rose to 83 among adults reared from the first-laid eggs. Newly emerged males and females prevented from pairing went into diapause in 2–3 weeks. Experiments designed to show the male influence on diapause gave inconsistent results.

In tests to show the influence of temperature, all adults of the first three post-diapause generations entered diapause when their feeding periods were interrupted by exposure to a temperature of 10°C. [50°F.] for at least 14, 5 and 2 days, respectively, and all females of the first and second generations entered diapause without ovipositing when they were kept during the pupal stage for 14 and 10 days, respectively, at 5°C. [41°F.] or 8 and 5 days at 35°C. [95°F.]. Similar experiments in which larvae were exposed to cold showed the same general tendency, but exposure of the eggs had no effect. Extremes of humidity and darkness also increased the proportion of adults to enter diapause. Light had an indirect effect, acting through the food-plant, the percentages of beetles kept in darkness and fed on potato leaves grown in the open or in artificial light that entered diapause immediately being 37 and 100, as compared with 13 and 61 when the beetles were kept in daylight. The tendency to diapause was higher among insects fed on other solanaceous plants than among those fed on potato.

The duration of the diapause averaged 104·6 days for adults that entered diapause as a result of unfavourable external conditions and 142·2 days for those that did so for physiological reasons. The shortest diapause (six weeks) was observed among beetles exposed continuously to a daylight lamp. The beetles sometimes burrowed more deeply if the soil became wet, but remained immobile in petri dishes for months under conditions of normal temperature and humidity and strong light. Respiration was slight, and two beetles survived immersion in water for ten weeks [*cf.* **20** 193]. After the diapause, the beetles remained inactive until the water content of their bodies had risen. They then emerged from the soil if the temperature was favourable and resumed normal activity.

Geier (P.) & Mathys (G.). **Contribution à la connaissance des conditions d'action de l'acide cyanhydrique (HCN) sur le Pou de San-José (*Quadraspidiotus perniciosus* Comst.), en cellules étanches et à pression atmosphérique.**—*Landw. Jb. Schweiz* **63** pt. 6 pp. 543–556, 2 figs., 9 refs. Berne, 1949. (With a Summary in German.)

Experiments were carried out, mostly on apple, in Switzerland in 1949 to develop standards for fumigation of fruit-tree nursery stock with hydrocyanic acid gas against *Quadraspidiotus perniciosus* (Comst.). The gas was generated by the pot method from sodium cyanide used at the rate of 1 oz. per 1 fl. oz. sulphuric acid (66°Bé.) in 3 fl. oz. water and was introduced into a chamber that is described. The volume of the chamber was nearly 110 cu. ft. and provision was made for circulating the gas. The speed of generation was not appreciably affected by temperatures of 0–25°C. [32–77°F.] provided that the sulphuric acid and water were not mixed until the last minute, and effectiveness was not altered by relative humidities between 60 and 100 per cent. The dosages given below are the initial concentrations introduced (1 oz. HCN=2 oz. sodium cyanide) and not the concentrations in the chamber during the process of fumigation. Preliminary tests gave results in direct contradiction to those of other work [*R.A.E.*, A **31** 378] in that the effect of HCN was rapid and reached its maximum within about ten minutes; mortality of adult females (the most resistant stage) fumigated with 0·25 oz. HCN per 100 cu. ft. did not increase significantly when the exposure was increased from 15 to 45 minutes, and that of females fumigated with 0·4 oz. was complete after eight minutes but not after six. Owing to adsorption of the gas by

surfaces within the chamber, higher initial concentrations were needed to maintain mortality as the amount of plant material treated increased. When the fumigation chamber was filled and unfavourable conditions were created by keeping the Coccids at 4°C. [39·2°F.] for eight hours before treatment and fumigating them at temperatures usually below 10°C. [50°F.] and about 85 per cent. relative humidity, the lowest concentrations that gave complete mortality of overwintering and summer stages, for an exposure of 15 minutes, were 0·25 and 0·4 oz. per 100 cu. ft., respectively. These concentrations also gave complete mortality of scales on twigs covered with a film of water or caked with clay. No fruit trees of the sorts grown in Switzerland, even apricots, suffered damage when exposed while dormant to up to 1 oz. HCN per 100 cu. ft. for one hour, but it is recommended that the plants should be kept in the shade before and after treatment at high concentrations. It is concluded that fumigation for 30 minutes with 0·5 oz. per 100 cu. ft. is completely effective even under highly adverse conditions and can safely be recommended for practice.

Moursi (A. A.). **Contributions to the Knowledge of the natural Enemies of Mealybugs. 1. Description of two new Species of** *Anagyrus* **(Hymenoptera : Encyrtidae).**—*Bull. Soc. Fouad Ier Ent.* **32** pp. 1–7, 16 figs. Cairo, 1948. **2.** *Anagyrus kamali* **Moursi, a Parasite of the Hibiscus Mealybug,** *Phenacoccus hirsutus* **Green (Hymenoptera : Encyrtidae).**—*T.c.* pp. 9–16, 19 figs., 2 refs. **3.** *Anagyrus aegyptiacus* **Moursi, a Parasite of the Lebbek Mealybug,** *Pseudococcus filamentosus* **Ckll. (Hymenoptera: Encyrtidae).**—*T.c.* pp. 17–32, 31 figs., 5 refs. **4.** *Leptomastix phenacocci* **Compere, a Parasite of the Lebbek Mealybug,** *Pseudococcus filamentosus* **Ckll. (Hymenoptera : Encyrtidae).**—*T.c.* pp. 33–40, 22 figs., 1 ref.

Descriptions are given in the first paper of the adults of both sexes of *Anagyrus kamali* and *A. aegyptiacus*, spp. n., reared from *Phenacoccus hirsutus* Green (hibiscus mealybug) and *Pseudococcus filamentosus* (Ckll.) (lebbek mealybug), respectively, in Egypt. The second, third and fourth papers contain notes on the bionomics, with descriptions of the immature stages, of *A. kamali*, *A. aegyptiacus* and *Leptomastix phenacocci* Comp., which also parasitises *P. filamentosus* there. It is stated that though *Phenacoccus hirsutus* was formerly an important pest of many ornamental trees and shrubs [*cf. R.A.E.*, A **14** 571–572 ; **28** 273–274], its population has since greatly decreased, and this is attributed chiefly to parasitism by *A. kamali*, which is widely distributed in Egypt. *Pseudococcus filamentosus*, which is also polyphagous, caused great damage to lebbek trees [*Albizzia lebbek*] in Cairo in 1907–09. The bionomics of *A. aegyptiacus* and *L. phenacocci* were studied on populations of *P. filamentosus* reared on potato sprouts or fruits of pumpkin (*Cucurbita pepo*) in the laboratory ; *L. phenacocci* has been reported emerging in numbers from *Phenacoccus hirsutus* [*cf.* **27** 506], but was not reared from this species and did not oviposit on it in the laboratory.

The general bionomics of all three Encyrtids are similar. The early nymphal instars of the hosts are preferred for oviposition, and eggs were not laid in the male prepupae and pupae or the ovipositing females. Normally, only one egg was deposited in each host, and if several occur together, not more than two parasites complete their development ; immature stages of *A. aegyptiacus* and *L. phenacocci* were found in the same host in the field. All three species pass through six larval instars. First-instar larvae of *A. aegyptiacus* fed on the body fluids of the host, but larvae in the last instar destroyed the internal organs. Females of *P. hirsutus* that were attacked by *A. kamali* while they are in the second nymphal instar sometimes deposit a few eggs. Pupation takes place within the host, and adult parasites that developed in male hosts were

smaller than those that developed in females. The duration of development varied with temperature and the age of the host, the first instar being prolonged in hosts in the first nymphal instar. The development of *A. kamali* lasted about 18 days at 25°C. [77°F.], that of *A. aegyptiacus* 28 days at 25°C. and 16 at 31°C. [87·8°F.] and that of *L. phenacocci* 20 and 30 days at 27°C. [80·6°F.] in host nymphs that were 20 and 10 days old, respectively. The two sexes were equally numerous, and mating and oviposition took place soon after emergence. Adults of *A. kamali* and *A. aegyptiacus* survived for 37–131 and 36–113 days in winter, and females kept in the laboratory oviposited readily after 42 days and three weeks, respectively, when suitable hosts were provided ; males of *L. phenacocci* survived for 5–60 days and females for 19–78. All three species breed continuously, provided that hosts are available. Adults were observed to emerge in outdoor cages during December–March, when few hosts are present and parasite numbers are low ; peak populations of all three were reached in September–October. At that season the percentage parasitism of *P. hirsutus* by *A. kamali* reached 66–87·2 on *Hibiscus cannabinus*, 75–87·2 on *H. esculentus* and almost 100 on guava and custard apple [*Annona squamosa*], while combined parasitism of *Pseudococcus filamentosus* by *A. aegyptiacus* and *L. phenacocci* was 80–90 per cent. ; parasitism by these two species is complementary, the total being unaffected by a scarcity of one of them. *A. aegyptiacus* was parasitised by a species of *Pachyneuron* that oviposited and developed on the pupae, several individuals completing their development on a single host, and was most abundant when the *Anagyrus* population was at a peak. *A. aegyptiacus* and *L. phenacocci* both emerge from adult females and male prepupae of *P. filamentosus*, but it is stated in the third paper that *Acerophagus* sp., another important parasite of that mealybug that is often overlooked owing to its small size, completes its development in the first-instar nymphs and is common in winter and early in the season.

Talhouk (A. S.). **A Note on *Blastodacna libanotica* Dkff. (Lepidoptera : Cosmopterigidae).**—*Bull. Soc. Fouad Ier Ent.* **32** pp. 41–45, 6 figs., 2 refs. Cairo, 1948.

Galls collected on pear twigs near Beirut (Lebanon) in 1938 were found to be caused by a Cosmopterygid that was described as *Blastodacna libanotica* by A. Diakanoff in the following year. Observations showed that the adults emerge in February and March, the males usually 3–4 days before the females. The newly hatched larvae bore upwards in the twigs of the current season, entering through the internodes, and their movements and the manner in which the galls develop as a result of their feeding are described. Each larva causes a separate gall, which bulges towards one side in the lower half and towards the other in the upper half ; owing to their small size and their position, the galls remain inconspicuous until the leaves fall in autumn, when the larvae have pupated in them. In March 1942, four galls of abnormal shape were found on hawthorn [*Crataegus*], and four unidentified Ichneumonids emerged from them during 13th–18th March. A description of the larva of *B. libanotica* is included.

Zaazou (H.). **The Longevity of the Bean Weevil : *Acanthoscelides obsoletus* Say (Coleoptera : Bruchidae).**—*Bull. Soc. Fouad Ier Ent.* **32** pp. 51–70, 30 refs. Cairo, 1948. **Oviposition of the Bean Weevil : *Acanthoscelides obsoletus* Say (Coleoptera : Bruchidae).**—*T.c.* pp. 343–361, 21 refs.

Accounts are given in these two papers of investigations on survival and oviposition in *Bruchus* (*Acanthoscelides*) *obtectus* Say (*obsoletus*, auct.), for most of which, beetles reared in the laboratory at a mean temperature of about 24°C. [75·2°F.] and 70 per cent. relative humidity were kept with red kidney

beans [*Phaseolus*] conditioned to the required humidity. When males and females were isolated in pairs and kept at constant temperatures of 15, 18, 21, 25 or 31°C. [59, 64·4, 69·8, 77 or 87·8°F.] and relative humidities of 30, 55, 65, 75, 90 or 100 per cent., the survival period of the females was 10 per cent. longer than that of the males. At the preferred humidity of 90 per cent., the survival period of both sexes was almost doubled by a reduction of 10°C. [18°F.] in the temperature. Oviposition was intermittent at 15°C., and at all humidities the number of eggs deposited increased with temperature up to 25°C., which was the optimum. At 21 and 25°C., less than 1 per cent. of the eggs appeared to be infertile, but at 30°C., the percentage increased to over 5. At 25°C. and under, increases in atmospheric humidity up to 90 per cent. caused an increase in the survival period, which at 15 and 18°C. did not exceed 3·7 per cent., but at 21–25°C. reached a maximum of 12·6 per cent. for females and 11·7 per cent. for males. The duration of the survival period decreased at 100 per cent. humidity, and at 31°C., humidity did not influence survival. The influence of relative humidity on the number of eggs deposited was governed by temperature in a similar manner, and was greatest at 25°C. The duration of the oviposition period tended to decrease with increased temperature and to increase with increased relative humidity ; it was longest at 90 per cent. at all temperatures, and at 75 per cent., a temperature of 25°C. was the optimum. In a test with adults that had been reared at 55, 65 or 75 per cent. humidity and 21, 25 or 30°C. and were subsequently kept under standard conditions of 70 per cent. humidity and 25°C., beetles reared at low temperatures were larger and heavier than those reared at high ones. Those reared at 25°C. were the shortest lived, and the duration of the adult survival period increased slightly with increasing relative humidity during development. The numbers of eggs deposited increased in general as the relative humidity during development increased and the temperature decreased ; most eggs were laid by females reared at 21°C. The pre-oviposition periods of females reared at 30°C. were very long, sometimes exceeding six days. Newly emerged adults do not immediately leave the beans in which they have developed. The period for which they remained in them decreased as the rearing temperature increased, and it is suggested that this habit may account for the increased survival and oviposition periods of beetles reared at high temperatures, though the same effect might be brought about by uneven development of different organs at high temperatures, as a result of which the beetles emerge before being fully mature. Adults that paired did not live so long as those prevented from doing so.

In warehouses, conditions are favourable for oviposition by *B. obtectus*, but there is no food for the adults, which survive for only two weeks. In the field, the adults probably emerge just before the crop becomes suitable for oviposition, but light infestation is sometimes caused by adults that emerge early and prolong their life by feeding. In experiments, beetles allowed access to water survived for only slightly longer than others kept without food or water ; the females deposited a larger average number of eggs, but the duration of the oviposition period in both was about the same. The fat-bodies of adults deprived of water were scarcely used at death, whereas those of 10 per cent. of the adults provided with water were completely exhausted. The survival period was extended to maxima of 81 days for males and 89 for females when the beetles were given honey, and to 74 and 85 days when they were given sugar solution. There were corresponding increases in the numbers of eggs produced of nearly 97 and 89 per cent., respectively, and the fat-bodies of these females were exhausted at death. There was little difference in the survival periods of adults from larvae reared on beans of different types or peas, but females laid about three times as many eggs on pea beans, red and white kidney beans and Black Valentine beans as on lima beans, haricot beans and garden peas. When

groups of up to seven unmated males or females were kept in tubes 2×1 in. in size, each containing two red kidney beans, the average survival period was longest at a density of about six. When 1–128 pairs of beetles were confined in petri dishes each containing 160 pea beans, the number of adult progeny obtained per female was highest (57·5) for two pairs, and the greatest number of progeny (217) developed when eight pairs were present.

GHABN (Abdel Aziz Ali El-Sayed). **Contribution to the Knowledge of the Biology of *Thrips tabaci* Lind. in Egypt (Thysanoptera).**—*Bull. Soc. Fouad Ier Ent.* **32** pp. 123–174, 1 col. pl., 19 figs., 210 refs. Cairo, 1948.

Prior to 1930, the damage caused by *Thrips tabaci* Lind. to cotton seedlings in Egypt was inconspicuous and was attributed to other insects, but the thrips subsequently became of such importance throughout the country that studies of its bionomics were begun in 1936. This paper contains an account of its life-history based on the results and the literature, together with descriptions of the immature stages and of the adult female, the damage that it causes, its world distribution, and lists of its food-plants and natural enemies recorded in Egypt and in other countries. Males are rare. The thrips were reared in the laboratory at temperatures of about 18–33°C. [64·4–91·4°F.]. Development lasted 9–23 days, and the adults survived for 1–30 days. Of a total of 1,044 females, only 765 oviposited, and of the 3,459 eggs laid, only 38·5 per cent. hatched. At 22–27°C. [71·6–80·6°F.], mortality among first- and second-instar nymphs averaged 17·6 and 13·1 per cent., respectively. The winter is passed on weeds and grasses in the fields or near canals and on crops, chiefly in the adult stage, though nymphs were seen after warm spells in late December and early March. Six complete generations developed in the laboratory between August and December, and adults of a seventh overwintered until March ; it was estimated that a further eight overlapping generations developed between March and August. Dispersal takes place by active migration and by wind carriage. In laboratory experiments, the adults and, to a less extent, the nymphs showed a tendency to move upwards and a stronger one to avoid light ; nymphs, pupae and adults all showed a tendency towards positive thigmotropism.

T. tabaci is most injurious in Lower Egypt, where in some years it destroys 90 per cent. of the young cotton plants, and least so in Upper Egypt, which is too dry for it during much of the year ; the differences in activity in the different regions of Egypt are shown to be due to differences in temperature and humidity. Adults of *Oecanthus turanicus* Uvar., *Orius albidipennis* Reut. and *Coccinella undecimpunctata* L. and larvae of *Chrysopa vulgaris aegyptiaca* Nav. were observed feeding on nymphs and adults of *T. tabaci*, and larvae of *Syrphus corollae* F. on the nymphs. Other predators of *T. tabaci* found by H. Priesner in Egypt are *Orius laevigatus* (Fieb.) and an undescribed species of *Aeolothrips* closely related to *A. collaris* Priesn. These natural enemies are not effective control agents. *T. tabaci* has been found on 129 food-plants in Egypt, of which the two of greatest economic importance are cotton and onion. Since many are weeds, clean cultivation should be of value in checking infestation.

HANNA (A. D.). **Studies on the Mediterranean Fruit-fly, *Ceratitis capitata* Wied. (Diptera-Trypaneidae). III. Factors limiting the Attack of the Mediterranean Fruit-fly in Citrus Fruits.**—*Bull. Soc. Fouad Ier Ent.* **32** pp. 175–202, 1 col. pl., 4 figs., 1 graph, 15 refs. Cairo, 1948.

In this third paper of a series [*cf. R.A.E.*, A **38** 452], an account is given of investigations on the part played by the fruits themselves in limiting attack

by *Ceratitis capitata* (Wied.) on *Citrus* in Egypt. Detailed analyses of the juice of various *Citrus* fruits failed to show any correlation between acidity and infestation, and in other tests, none was found between infestation and the thickness of the rind or its mechanical resistance to the ovipositor. Studies of the main constituents of the rind indicated that the total content of pectins decreases as the fruits ripen and varies more from month to month in Egyptian limes and lemons, which are not attacked, and Egyptian tangerines, on which infestation is heavy, than in other kinds of *Citrus* that are less heavily attacked, but that whereas that of the first two remains fairly high, that of the last falls suddenly to a low level ; the concentration of pectins in the water of the rind showed a similar variation. *Citrus* fruits in Upper Egypt are not attacked, although peach in that region is heavily infested, and the pectin and water contents of the rind of *Citrus* fruits grown there did not differ appreciably from those in Lower Egypt. The absence of infestation is attributed to climatic conditions, which favour the rapid drying of the rind round the oviposition puncture, so that the larvae cannot penetrate its walls. An index of infestation, based on the ratio between the total pectins in the fresh peel and its water content, the saturation deficiency of the air and the duration of the egg stage, is given. The indices for various *Citrus* fruits in each month of the year, except those in which the mean temperature is at or below the threshold of development (13·5°C. [56·2°F.]) and no infestation is likely, are shown for six places in Egypt.

High Nile floods were observed to favour infestation. Unfavourable conditions of humidity can be produced by spacing the trees far apart, providing good drainage, and watering the trees sparingly.

Ossowski (L. L. J.). **Notes on the chemical Control of the Wattle Bagworm (*Acanthopsyche junodi* Heyl.), 1949–1950.**—*Rep. Wattle Res. Inst. 1949* pp. 36–42. Pietermaritzburg, 1950.

The application of insecticides from aircraft has been considered the best method of controlling *Acanthopsyche junodi* (Heyl.) on wattle [*Acacia*] over large areas in South Africa [*cf. R.A.E.*, A **37** 178]. However, since infestation of a plantation is initially due to carriage of the insects by air currents and spreads through it only gradually, perimeter spraying by means of mobile equipment moving along roads, fire-breaks and headlands in the early stages of infestation would probably give protection. Preliminary surveys in 1949 showed that penetration in the first year of attack does not exceed 12–15 yards. If perimeter spraying is to be practised, the trees should be planted more thickly than usual in the four outside rows of a plantation and left unpruned, and the undergrowth should be left standing, in order to concentrate the migrating larvae, and careful surveys for infestation should be made.

Small-scale experiments in 1948 showed that a solution of 0·25 per cent. γ BHC (benzene hexachloride) in diesel oil, atomised at a rate of about 3–4 gals. per acre from hand-operated equipment, was effective against larvae in the first two instars, and in 1949–50, field tests were made with BHC at 2–4 per cent. γ isomer and toxaphene at 2·5–10 per cent. of the commercial product in mineral oil (Diesoline), applied as fogs by means of a Todd Insecticide Fog Applicator [*cf.* **35** 259] mounted on a jeep or on a trailer pulled by a jeep. In the first, in mid-December, 2, 3 and 4 per cent. γ BHC gave 45·3–88·3, 27·3–44·8 and 48·6–100 per cent. mortality, respectively, the 3 per cent. fog rising very rapidly and covering only two rows of trees. In a block in which the three concentrations were compared, the 2 per cent. fog was the most effective, apparently owing to better coverage. In the second test, in mid-January, three applications on the same day of 3 per cent γ BHC only partly enveloping a sample tree in a plot for five seconds gave only 37·5 per cent. mortality, whereas one application of 3 per cent. γ BHC covering the tree for 30 seconds

gave complete mortality and one of 2 per cent. covering the tree for 15 seconds 61·1 per cent. Many larvae, especially those in the last instars, left their bags when these became saturated with insecticide, and such larvae did not survive when taken to the laboratory. In the third, applications were begun rather later, on 31st January, when nearly 2 per cent. of the Psychids were in the prepupal stage, and even 10 per cent. toxaphene enveloping the tree for 12 seconds did not penetrate the strong silk lining of the bags of these. Single applications of 2·5 per cent. toxaphene enveloping the trees for 5 and 12 seconds gave 48·4 and 66·3 per cent. mortality, respectively, and two gave 79 per cent. mortality when the tree was enveloped for 12 seconds in the fog and 94·5 per cent. when it was enveloped for 12 seconds in direct fog and for 7 seconds in returning drift, but 5 per cent. toxaphene gave poor results as the fog rose too rapidly, and 10 per cent. was about as effective as 2·5 per cent. when the time of coverage was approximately the same. Two applications of toxaphene at 2·5 per cent. gave a higher kill than one of 4 per cent. γ BHC, and oil alone gave 10 per cent. mortality when the trees were enveloped once for four seconds.

It is concluded that both compounds are effective against *A. junodi*. BHC acts more quickly, the difference in mortality of larvae collected one and six days after application being only 13·1 per cent., but toxaphene has the greater ultimate toxicity. Mortality was very high in the first four instars and lower in later ones, but was still satisfactory when good cover was obtained. The results indicated that 2 per cent. γ BHC or 2·5 per cent. toxaphene gave effective control and that spraying twice gives better results than spraying once with twice the concentration of the same material. Cloudy, even drizzly, windless days appeared to be the best for treatment, as the insecticidal fog remained longer in the crowns of the trees and saturated the bags. The larvae fed partly out of their bags on sunny days and were more easily killed, but under hot conditions the fog rose too quickly and did not sufficiently cover the whole area. BHC also killed many other insects, including not only Lasiocampids, but also pollinators, parasites and predators.

STEPHENSON (P. R.). **Report of the Desert Locust Survey, 1st October, 1948–30th September, 1950.**—[2+] 45 pp., 13 figs., 2 fldg. maps in pocket. Nairobi, E. Afr. High Comm., 1951.

After the last outbreak of *Schistocerca gregaria* (Forsk.) in East Africa and the Middle East, a meeting of locust experts at Nairobi in February 1948 recommended that an international organisation should be set up to explore and keep under observation the area adjoining the Red Sea and Persian Gulf where outbreaks are believed to originate and that, until this was done, the existing control organisations should be formed into the Desert Locust Survey, to operate in the suspected areas in Somalia, British Somaliland, Ethiopia, Eritrea, the Aden Protectorates, Yemen, Saudi Arabia and Oman in close co-operation with other interested countries. The Survey was constituted a Department of the East Africa High Commission on 1st October 1948, and in addition to surveying the suspected areas, it was also to investigate the factors affecting swarming ; an Advisory Committee was set up to advise the High Commission and Survey on pertinent matters.

During 1949, reconnaissance teams mapped the major vegetational divisions and the distribution of locusts in the coastal areas of Eritrea, western Saudi Arabia, where they collaborated with an Egyptian unit, and British Somaliland, and there was also an observer in Yemen and a small unit in Oman, where a team had been sent from Pakistan. Locusts were not abundant except in Eritrea, where abnormal flooding resulted in the formation of incipient swarms, but these were successfully controlled with help from the Anglo-Egyptian Sudan ; furthermore, the inhabitants of some coastal areas agreed to plant their crops

according to the instructions of the Survey to provide data on distribution. Heavy rains also caused the development of swarms on the Trucial Coast, Oman, which were reported by the Pakistan unit early in 1949. These constituted the beginnings of a new and unexpected outbreak, the development of which up to about October 1950 is outlined from the incomplete data available. By September 1949, it had spread to such an extent that it formed a threat to the Indian subcontinent, and a meeting was called at Karachi, which was attended by technical representatives from Egypt, France, India, Pakistan, Persia and the United Kingdom and by an observer from the Food and Agriculture Organisation of the United Nations. As it was thought that the new outbreak could be arrested and that Oman was the crucial area, a combined unit from Pakistan, India and Persia was stationed there to work with the team from the Desert Locust Survey. Winter control campaigns were carried out in the Aden Protectorates, British Somaliland, Yemen and western Saudi Arabia. A bait of bran and BHC (benzene hexachloride) was effective against the hoppers in the first two and in western Saudi Arabia, where considerable assistance was given by an Egyptian unit, the Saudi Arabian government, and local cultivators, but in Yemen it was greatly inferior to a dust containing 20 per cent. crude BHC, which was used with such success by the inhabitants that the Yemeni government requested that the number of Survey officials stationed in the country should be increased and that stores of BHC should be established at strategic points. This dust and one containing 14 per cent. dinitro-o-cresol gave good control of roosting adults in Aden, but was of no value against a mature swarm in Yemen.

At the end of January 1950, breeding was causing concern in British Somaliland, where winter control activities were hampered by lack of staff and suitable transport. It was apparent that even complete control in the areas of the Red Sea and the Gulf of Aden could not alone prevent a new outbreak, and breeding was expected in western Saudi Arabia. A small Executive Committee was therefore set up to deal with immediate control problems, and in May 1950, when swarms were present from Pakistan to Eritrea, the Desert Locust Survey was instructed by this Committee to draw up plans for a control organisation. At meetings of the Executive and Advisory Committees in July–August 1950, attended by all available *Schistocerca* experts, including observers from Egypt, Ethiopia, Italy, the Anglo-Egyptian Sudan and Yemen and representatives from the Anti-Locust Research Centre and the British Colonial Office, plans were approved for operations in the eight countries originally covered by the Survey and Kenya and providing for full-scale control campaigns for a minimum of three years and reduced measures for a further two, and Italy and Egypt were invited to appoint technical representatives to the Advisory Committee. The organisation of control measures was handed over to the newly formed Desert Locust Control Organisation at Nairobi on 15th August 1950. Campaigns to control summer breeding were carried out successfully by the Survey during May–September 1950 in northern and eastern Ethiopia, Somalia and Eritrea.

LEVER (R. J. A. W.). **The Tea Mosquito Bugs (*Helopeltis* spp.) in the Cameron Highlands.**—*Malay. agric. J.* **32** no. 2 pp. 91–109, 2 pls., 8 figs., 22 refs. Kuala Lumpur, 1949.

Two Mirids of the genus *Helopeltis* attack tea in the Cameron Highlands of Malaya, *H. bradyi* Waterh. and one identified in 1935 and 1937 as *H. cinchonae* Mann. The author considers that discrepancies between the latter and the original description of *H. cinchonae* from Assam and Bhutan render this identification uncertain, but he retains the name provisionally. He describes the nymphs and adults of both species, shows that infestation increased from 1930, when it was first reported, until 1940, shortly before observations had to

be suspended, and summarises the measures tested against them in that period. No evidence of the establishment of the predacious Reduviids liberated against them in 1940 [*cf. R.A.E.*, A **30** 339, 396] was obtained in 1941 or on the resumption of investigations in 1947–48.

The nymphs and adults damage the plants by sucking the sap from the leaves, and to some extent from the buds and young stems, and the slits in the young stalks in which the eggs are laid also cause some injury. The egg and nymphal stages lasted 19 and 40 days for *H. cinchonae* and 14 and 34 for *H. bradyi* in October–December 1947, and the egg stage varied from 15–19 and 9–13 days, respectively, in May and June 1948 to 16–22 and 13–17 days in November 1948.

Preliminary tests on control with insecticidal dusts showed that 5 per cent. DDT in talc applied at 20–25 lb. per acre gave the best protection ; it was more lasting in effect than pyrethrum dust and affected the taste of the tea less than benzene hexachloride. Heavy rain made frequent dusting necessary. Attempts to obtain lasting control by dusting with 20, 40 or 60 lb. 5 per cent. DDT at intervals of ten days (the normal estate interval for plucking) in February and July were not completely successful, but damage was reduced considerably by all treatments, and it is recommended that dusts should be applied at not less than 30 lb. per acre three times at ten-day intervals during the driest times of year, and that as large an area as possible should be treated at one time. Lower concentrations of DDT gave slower kills of nymphs and adults. The bugs often occur in fairly small concentrations, and these should be treated with a hand duster as soon as found.

Field and laboratory observations showed that the ratio of males to females was about 1.: 2 for *H. bradyi* and 2 : 1 for *H. cinchonae*. A Mymarid parasite bred from eggs of *H. cinchonae* from various localities in Malaya was described by Gahan as *Erythmelus helopeltidis* [**39** 452], and in 1948 apparently the same parasite was bred from eggs of *Helopeltis* in the mountains of western Java, to which island a consignment of parasitised eggs was sent from the Cameron Highlands in January 1948. The duration of development of the parasite within the eggs ranged from 26 days at 65·6°F. in May to 42 days at 63·5°F. in November. An average of 50·8 per cent. of the eggs of *H. cinchonae* collected in the field gave rise to neither host nor parasite, and 36 per cent. of the remainder were parasitised. Although reared only from eggs of *H. cinchonae* in the field, the parasite oviposited and developed normally in those of *H. bradyi*. Another egg-parasite and an Ichneumonoid, the latter from *H. bradyi* and both of negligible importance, were also observed.

In Malaya, *H. bradyi* has been taken only on tea, *Cinchona* spp. and gutta percha (*Palaquium gutta*), but *H. cinchonae* has been collected on plants of 60 species, of which about a dozen are of economic importance. The other two species of *Helopeltis* that occur in Malaya are *H. theobromae* Miller, which attacks cacao and annatto [*Bixa orellana*] and was taken on tea in the plains in 1948, and *H. sumatranus* Roepke, which is scarce and infests *Uncaria gambier*.

LEVER (R. J. A. W.). **A new Coconut Pest in Singapore.**—*Malay. agric. J.* **34** no. 2 pp. 79–82, 12 refs. Kuala Lumpur, 1951.

Promecotheca cumingii Baly, a pest of coconut in the Philippines [*cf. R.A.E.*, A **20** . 214], was found on coconut and, in small numbers, on nipa [*Nipa fruticans*] and sago palms in and near Malacca by Burkill in July 1907, but did not become established there ; Burkill's record has been noticed [**6** 523], but the sago palm (*Metroxylon*) was erroneously cited as *Caryota urens*. In April 1951, this Hispid was found on coconut in Singapore, having probably been introduced on plant material imported by air from the Philippines late in 1949, and the area of infestation spread somewhat during April–August.

It occurred also on areca, oil palm and royal palms [*Areca catechu*, *Elaeis guineënsis*, and *Oreodoxa regia*] in June, but damaged them less severely.

The eggs of *P. cumingii* were laid on the lower sides of the coconut leaflets and hatched in 13–15 days in July–August 1951 in the laboratory at Kuala Lumpur. The larvae mined the leaflets, pupating in their mines, and the adults fed on the lower surfaces of the leaflets. The life-cycle lasted 7·5–8 weeks. Four Hymenopterous parasites bred from material collected in Singapore in June comprised *Ooencyrtus* sp., which attacked the eggs and was of negligible importance, *Pleurotropis parvulus* Ferrière, which attacked the larvae and was the most efficient of the four, a species of *Dimmockia* that was parasitic or hyperparasitic on the larvae, and a Eupelmid. Eggs collected in August were parasitised by *Achrysocharis promecothecae* Ferrière. The spread of the Hispid appeared to have been checked by August, possibly owing to parasitism by *P. parvulus*, and this indigenous Eulophid may possibly continue to give adequate control.

CARTER (M. W.). **The *Pittosporum* Chermid, *Powellia vitreoradiata* Mask.**—*N.Z. J. Sci. Tech.* **31** (B) no. 2 pp. 31–42, 5 figs., 3 refs. Wellington, N.Z., 1950.

Powellia vitreoradiata Mask. causes severe damage to the young growth of several species of *Pittosporum*, notably the hedge plant, *P. crassifolium*, in various parts of New Zealand; Maskell (1890) also recorded it on *Discaria toumatou* and *Geniostoma ligustrifolium* and stated that it occurred throughout the country. The nymphs feed on both surfaces of the leaves, causing them to become pitted and stunting the growth. Both nymphs and adults excrete quantities of honey-dew, which favours the development of sooty moulds. The eggs and nymphs of the Psyllid and the technique of rearing it are described, and the characters differentiating the five nymphal instars shown in a table. The egg and nymphal stages lasted 11–14 and 38–58 days, the nymphs developing more quickly on young leaves than on old, and caged adults lived for 20–90 days. The females had preoviposition periods of 5–38 days and laid 67–415 eggs in masses of up to 50 on the lower surfaces of the young leaves or on unopened buds. The nymphs were present throughout the year and populations were large during the main growing periods of the trees in spring and autumn. The size of the populations varied with the amount of new growth produced, except in summer, when the foliage hardened before development was completed, so that the nymphs died. This period was bridged by a limited number of nymphs that matured on foliage growing in the shade and by adult females that oviposited when the new foliage appeared in autumn.

Natural enemies comprised an Encyrtid parasite of the nymphs, of which only five examples were obtained, and Coccinellid larvae, small spiders and three Hemerobiids, all of which preyed on the Psyllid. The Hemerobiid, *Drepanacra binocula* (Newm.) was the most important, and observations on its habits are recorded. Its development in the laboratory required 27–30 days, and though it caused a marked reduction in populations in early spring, it did not exert effective control.

SPILLER (D.). **Toxicity of Arsenious Oxide, Sodium Fluoride, Zinc Chloride, and some other Materials, to the Common House Borer, *Anobium punctatum* De Geer.**—*N.Z. J. Sci. Tech.* **32** (B) no. 3 pp. 1–7, 4 refs. Wellington, N.Z., 1951.

Although zinc chloride, sodium fluoride and various arsenicals have been widely recommended for the protection of timber against insects, there is little information concerning their toxicity on which recommendations can be based.

The value of the first two and of sodium arsenate, arsenic trioxide and five other compounds in protecting timber against *Anobium punctatum* (Deg.) was accordingly investigated in New Zealand by means of a technique already described [*R.A.E.*, A **38** 138], the test wood being blocks cut from sapwood of *Podocarpus dacrydioides* and *Pinus radiata*. The following is based on the author's summary of the results. Arsenic trioxide gave complete mortality of larvae when the wood was impregnated with it at a concentration equal to 0·021 per cent. of its dry weight and showed considerable toxicity even at 0·005 per cent. Zinc chloride prevented the development of the larvae at 0·18 per cent., but not at 0·11 per cent. and below, and the corresponding percentages for sodium fluoride, zinc sulphate and thiourea were 0·19 and 0·12, 0·9 and 0·53, and 0·25 and 0·1. In preliminary tests, sodium arsenate prevented development at 0·5–2 per cent. and copper sulphate at 0·45–2 per cent. Barium chloride was ineffective at 0·02–1 per cent., and urea at 0·5–4 per cent.

LAMB (K. P.). **The Assessment of Mothproofing Efficiency.**—*N.Z. J. Sci. Tech.* **32** (B) no. 4 pp. 8–14, 2 figs., 22 refs. Wellington, N.Z., 1951.

The methods hitherto adopted for assessing the efficiency of mothproofing treatments are reviewed. Since none is very satisfactory over a range of concentrations, a new procedure for determining losses in weight of fabric or decreases in weight of frass was devised. Larvae of *Tinea pellionella* (L.) and *Tineola bisselliella* (Humm.), 30 days old, were used as test insects, but larvae of the latter are unsuitable for determinations of frass weight, since the frass cannot readily be separated from the silk webbing produced by them. *Anthrenocerus australis* (Hope) showed promise in preliminary tests, but its slow rate of reproduction renders it unsuitable for laboratory work. Treated and untreated samples of fabric are brushed, weighed, and placed in separate jars, in which they are kept at 80°F. and 75 per cent. relative humidity ; the test insects are confined with half the treated and half the untreated samples, the rest being left uninfested to provide a humidity check. After a fortnight, the samples are brushed to remove frass and runways and re-weighed as soon as possible to avoid changes in moisture content ; if *Tinea pellionella* is the test insect, the brushings are sieved and the screenings weighed as frass. The mean weights of each set of four samples before and after the experiment are corrected for humidity changes by means of Fletcher's formula (which is given), the percentage loss in weight due to feeding is calculated, and the efficiency of the treatment is estimated as the difference in the percentage loss in weight of fabric due to feeding in the treated and control samples or in the mean weight of frass produced in them, both expressed as percentages. The percentage mortality in each jar is recorded to provide an indication of the vitality of the test insects. Any treatment giving less than 50 per cent. efficiency is regarded as unsatisfactory. The results obtained by this method are relative, and apply only to similar fabrics tested under similar conditions. The efficiency or the efficiency probit may be plotted against the logarithm of the dose, and the value for 50 per cent. efficiency used as a reference figure for comparing different mothproofing agents on a similar test fabric.

SEWELL (T. G.). **Manuka Blight Survey.**—*N.Z. J. Agric.* **79** no. 2 pp. 101–104, 6 figs., 3 refs. Wellington, N.Z., 1949.

HOY (J. M.). **Control of Manuka by Blight.**—*T.c.* no. 4 pp. 321–324, 7 figs.

In the first of these papers, the author describes the appearance of the wild plants known as manuka (*Leptospermum scoparium*), which varies in growth from stunted bushes 3–4 ft. high to trees of 20–25 ft., and kanuka (*L. ericoides*),

which grows into trees 20–60 ft. high. Both are present on both islands of New Zealand, but manuka is the more widespread and occurs at higher altitudes, on bad soils and in regions swept by strong winds, whereas kanuka is more common in fertile, sheltered areas at lower altitudes.

Since 1935, and particularly since 1946, manuka in the Canterbury area has been dying owing to infestation by a species of *Eriococcus*. This mealybug excretes honey-dew, on which a sooty mould develops, and the advisability of spreading it artificially is discussed. Though the destruction of the plants would be of value to some farmers, particularly those on second- or third-class hill country, manuka is a cover crop for regeneration of native bush, grows on sour soils and on much reverting hill country that would be subject to erosion or invasion by other weeds if it were removed, and is an important source of firewood in some places.

A survey to determine the distribution of the mealybug showed that *Eriococcus, Coelostomidia wairoensis* (Mask.), *Ctenochiton flavus* Mask., *Inglisia leptospermi* Mask., and *I. ornata* Mask. occurred on both manuka and kanuka, but that *Eriococcus* rarely destroyed kanuka, and the other species had no effect on plant growth. *Eriococcus* appeared to occur naturally only in Canterbury and was not affected by soil or climatic conditions. It can be spread to new areas by transferring twigs infested with crawlers between May and September or whole infested bushes at any time of year, and apparently became established on one planting to which it was introduced. Since manuka is attacked and killed in all stages of growth, the Coccid might provide a means of complete eradication.

Some of the information in the first paper is amplified in the second. *Eriococcus* has not been observed to have more than one generation a year. Eggs have been found from March to August, and crawlers from May to September. The mealybug has killed very little kanuka, but much manuka over large areas throughout Canterbury. Infestation usually begins at the base of the plant and spreads upwards. The plants are not killed for five or more years in the case of trees 10–15 ft. high and 2–3 years for regrowth.

A small collection of twigs infested with crawlers was taken to Wairoa, North Island, in June 1948, and although two weeks elapsed between collection and liberation, *Eriococcus* had become established by July 1949 on most of the plants to which infested material had been tied ; the liberation point was at the top of an exposed ridge at an altitude of 1,800 ft. Near Napier, where *Eriococcus* had been established for about three years, several manuka plants close to the liberation point were dead, and infestation had spread to the edge of the stand, all the plants being infested ; infestation due to natural spread was found in another area of manuka nearly 100 yards away across the brow of a hill. However, numerous attempts to transfer the Coccid from Canterbury to others parts of New Zealand have failed, probably because *Coelostomidia* was used instead of *Eriococcus* or because the attempts were made when no crawlers were present. Differences between *Eriococcus* and *Coelostomidia* are described.

The results of destroying manuka growing under various conditions in Canterbury and in the North Island, where it controls erosion, are discussed in some detail. Dying manuka should not be burnt, as this destroys the natural succession of plants.

CUMBER (R. A.). **The Green Vegetable Bug** *Nezara viridula.—N.Z. J. Agric.* **79** no. 6 pp. 563–564, 3 figs. Wellington, N.Z., 1949.

EVERETT (P.). **Spread of Green Vegetable Bug.**—*Op. cit.* **80** no. 2 pp. 145–146, 4 figs., 1 map, 3 refs. 1950.

In the first of these papers, it is reported that *Nezara viridula* (L.) was first recorded as a pest in New Zealand in April 1944, when it was found attacking

beans in the New Plymouth area of the North Island, and that it has since spread considerably in the extreme north. It may be confused with the native *Glaucias amyoti* (Dall.) and with *Cuspicona simplex* Wlk., which was accidentally introduced from Australia, and characters distinguishing it from them are described. The adults overwinter in long grass, foliage and hedges, resume activity in early spring and pair, the females ovipositing a week later. The eggs are laid in groups, usually of 60–80, on the underside of the leaves and hatch in about ten days. The life-cycle is estimated to last about eight weeks under the most favourable conditions in Northland, where all stages are present for at least six months of the year and there are probably 2–3 generations a year. The bug infests many cultivated plants and weeds, and has been observed breeding in neglected gardens and roadsides far from cultivation. Flowers, developing seeds, growing points and foliage are all attacked.

Of the two parasites, *Microphanurus basalis* (Woll.) and *Trichopoda pennipes* (F.), known to attack *Nezara*, the first, which parasitises the eggs, was introduced into New Zealand from Australia in 1949. About 48,000 examples were reared in the laboratory and liberated in six areas, and parasitised egg-masses and emerging parasites were later found at three of them. The destruction of possible hibernation sites, the burning of old infested plants and the destruction by hand of adults and nymphs, particularly early in the season, are suggested as control measures.

In the second paper, it is shown that infestation by *N. viridula* has extended rapidly in the North Island and that its food-plants include nearly all the vegetables commonly grown in New Zealand. Small-scale tests in Northland in 1949–50 showed that one application of a spray containing 0·05–0·1 per cent. DDT on runner beans gave good control of nymphs and adults for not less than eight days and that a second application 16 days later gave good control for at least another 26 days. Such sprays should not be applied to spinach and similar plants less than a month before harvest, to tomato plants less than a week before harvest or to cauliflower after the curd begins to form, and they cause such severe damage to some cucurbits that their use on them cannot be recommended. If infestations of red mites develop after the use of DDT, occasional applications of a dust of sulphur and hydrated lime should be made.

EVERETT (P.). **Control of Soft Wax Scale on *Citrus* Trees.**—*N.Z. J. Agric.* **81** no. 4 p. 344. Wellington, N.Z., 1950.

Ceroplastes destructor Newst. is present on *Citrus* in New Zealand at Kerikeri (Bay of Islands County) and Devonport (Auckland), and tests on its control with DDT were carried out on grapefruit at Kerikeri in 1949. A spray of 1 lb. 50 per cent. DDT wettable powder per 100 gals. water, applied at a pressure of 425–450 lb. per sq. in. to give complete tree coverage on 21st February or 3rd March or both, gave little or no control, whereas one of 3 per cent. oil in an emulsion spray gave good commercial control when applied on 21st February and excellent control when applied on this date and on 16th March [*cf. R.A.E.*, A **34** 21].

WINTERINGHAM (F. P. W.), BRIDGES (R. G.) & HARRISON (A.). **Potentiometric Analysis of Bromide-Chloride Mixtures at low Concentrations. Application to Fumigant Mixtures.**—*J. Sci. Food Agric.* **1** no. 6 pp. 185–189, 4 figs., 21 refs. London, 1950.

Methyl bromide is being increasingly employed as a fumigant against insect pests of stored products, but as it is highly toxic to man and has no distinctive odour, its use in admixture with chloropicrin as a lachrymatory warning gas

has been tried. For other reasons, such as enhanced penetration into bulked material, it has been applied with other chlorohydrocarbons, such as ethylene dichloride. When the distribution of such mixtures under fumigation conditions is studied, data on the concentrations of the single components in the air spaces become important, and the author describes the application of a potentiometric method to the analysis of binary mixtures of methyl bromide with chloropicrin, ethylene dichloride or carbon tetrachloride. The method is suitable for the analysis of samples of low concentrations drawn in evacuated flasks.

WINTERINGHAM (F. P. W.), HARRISON (A.), JONES (C. R.), MCGIRR (J. L.) & TEMPLETON (W. H.). **The Fate of labelled Insecticide Residues in Food Products. I. Studies with a radioactive Bromine Analogue of DDT.**—*J. Sci. Food Agric.* **1** no. 7 pp. 214–219, 2 figs., 17 refs. London, 1950.

The following is the authors' summary of this paper, in which the asterisk denotes ^{82}Br-labelled material. A radioactive bromine analogue, 1 : 1 : 1-trichloro-2 : 2-di-(4-bromo*phenyl)ethane, of the insecticide DDT has been used to indicate the fate of DDT sprayed on to wheat grain which is subsequently milled, baked and fed to animals. ^{82}Br of high specific activity was prepared in the Harwell pile by the Szilard-Chalmers method and was used for the synthesis of the analogue. Grain carrying 40·2 p.p.m. of the labelled insecticide was milled under typical conditions. A concentration of 14·6 p.p.m. was found in the flour (85 per cent. extraction) and 11·2 p.p.m. in bread made from the flour. There was evidence that some of the insecticide was in a combined form in the bread. Some of the grain and bread were fed to hens and rats respectively. The insecticide was found in all the tissues examined. A fraction of the radioactivity found in the excreta behaved as the di-(4-bromo*-phenyl)acetic acid metabolite. This metabolite was identified in the urine of a man following ingestion of some of the bread.

DELONG (D. M.) & SEVERIN (H. H. P.). **Characters, Distribution, and Food Plants of Leafhopper Vectors of Virus causing Pierce's Disease of Grapevines.**—*Hilgardia* **19** no. 6 pp. 171–186, 10 figs., 25 refs. Berkeley, Calif., 1949.

SEVERIN (H. H. P). **Life History of the Blue-green Sharpshooter,** *Neokolla circellata.*—*T.c.* pp. 187–189, 4 refs. **Transmission of the Virus of Pierce's Disease of Grapevines by Leafhoppers.**—*T. c.* pp. 190–202, 4 pls. (2 col.), 1 fig., 40 refs.

In the first of these papers, a list is given of 14 Jassids that have been shown to transmit Pierce's disease of grape vines, a virus disease that has become widespread and destructive in California [*cf. R.A.E.*, A **33** 172], with descriptions of distinctive characters and records of distribution and new localities and food-plants for ten. These are *Helochara delta* Oman, *Carneocephala fulgida* Nott., *Draeculacephala minerva* Ball, *Neokolla severini* DeL. [*cf.* **39** 254–255], *Hordnia* (*Neokolla*) *circellata* (Bak.), *Keonolla* (*N.*) *confluens* var. *pacifica*, n., *Pagaronia confusa* Oman, *P. tredecimpunctata* Ball, *P. triunata* Ball and *Friscanus friscanus* (Ball). The usual food-plants of most of them are grasses, though some have been collected on species of *Vinca*, some on various weeds and *H. circellata* on grape vine and other woody plants. The only other species recorded in the list of vectors and not in a previous list [**33** 172] is *Pagaronia furcata* Oman.

It is stated in the second paper that since *H. circellata* is one of the most important vectors of the disease, especially in the north coastal vineyards of California, its life-history was investigated in 1943–48. The eggs are deposited singly in slits in the petioles or the midribs of the leaves of vines, and those laid

in March–May in the greenhouse hatched in 16–22 days. There were 4–6 nymphal instars, and the nymphal stages of males and females averaged 47–52·7 and 46·3–51·3 days on grape vine and 57·6 and 66·2 days on lucerne. The adults appeared during the summer, overwintered, and died in the following spring. At Berkeley, there was usually one generation a year, but a partial second developed in 1944 on *Parthenocissus tricuspidata* and *Statice perezii*.

The experiments recorded in the third paper were undertaken to ascertain which of nine Jassids (all those described in the first paper except *Pagaronia tredecimpunctata*) are the most important vectors. Since the virus also causes dwarf disease of lucerne, tests with that plant were included. In experiments with single adults, the percentages that transmitted the virus from infected to healthy vines were 65 for *Hordnia circellata*, 33 for *C. fulgida*, 32 for *Helochara delta*, 13–15 for *D. minerva*, *F. friscanus* and *N. severini*, 6 for *P. confusa*, and 0 for *P. triunata* and *K. confluens* var. *pacifica*. In tests with *Hordnia circellata*, *D. minerva*, *P. confusa* and *P. triunata*, only the first two transmitted the virus from vines to lucerne (35 and 1 per cent. doing so, respectively), and these four species and *F. friscanus* failed to transmit it from infected to healthy lucerne. No transmission from lucerne to grape vine was obtained in a test with *P. confusa*. Adults of *P. confusa*, *P. triunata* and *F. friscanus* soon died when kept on diseased or healthy lucerne or grape vine in the greenhouse, and this may partly account for the low percentages of transmission obtained with these species. In transfers from infected to healthy vines, the minimum latent period was two hours in *H. circellata* and *C. fulgida* and seven hours in *D. minerva*. In the greenhouse, adults of *H. circellata*, reared on infected grape vine, retained the virus throughout adult life, in the case of one male for 122 days.

In subsidiary tests, the Jassids, *Circulifer* (*Eutettix*) *tenellus* (Bak.), *Xerophloea vanduzeei* Lawson and the long- and short-winged races of *Macrosteles divisus* (Uhl.), the Issids, *Hysteropterum severini* Caldwell & DeL. and *Naethus maculatus* Mel., and nymphs of unidentified cicadas that survived on the roots of diseased and healthy grape vines for months all failed to transmit the virus.

Papers noticed by Title only.

Blunck (H.). **Erfahrungen mit neuartigen Insektiziden im Ausland.** [Experience outside Germany with new Types of Insecticides (a review of the literature).] —*Z. angew. Ent.* **31** pt. 1 pp. 77–98, 50 refs. Berlin, 1949.

Mamet (R.). **A Food-plant Catalogue of the Insects of Mauritius.**—*Bull. Dep. Agric. Mauritius* Sci. Ser. no. 30, [1+] 74 pp., 34 refs. Port Louis, 1948.

Mamet (R.). **An annotated Catalogue of the Coccoidea of Mauritius.**—*Mauritius Inst. Bull.* **3** pt. 1 pp. 1–81. Port Louis, 1949.

Thompson (W. R.). Ed. **A Catalogue of the Parasites and Predators of Insect Pests. Section 2. Host Parasite Catalogue. Part 1. Hosts of the Coleoptera and Diptera.**—10¾×8½ ins., [1+]ii+147 pp. multigraph. Ottawa, Ont., Commonw. Inst. biol. Contr., 1951. Price $ (Canad.) 2. (Also obtainable from the Commonw. agric. Bur., Farnham Royal, Bucks, price 10*s*.) [*Cf. R.A.E.*, A **32** 106; **39** 220.]